Research Note 83-19

SOCIAL PSYCHOLOGICAL AND INSTITUTIONAL CORRELATES OF UNIT EFFECTIVENESS

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Survey and record data measures of a broad range of variables were collected from 60 combat line companies. Factor and item analyses were used to derive survey measures of Leadership Climate, Leader Strictness, Enlisted Cohesion, Enlisted Commitment, Racial Climate, Moral Climate, and Unit Effectiveness. Almost all of the possible inter-correlations between these survey scales were significant. When record data measures were correlated with the survey measures, officer experience, NCO experience, awards and commendations, and enlis-

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ted turbulence produced generally positive correlations with the survey scales (ie. were associated with more positive perceptions of the unit). Officer turbulence, Article 15s, AWOLs, MP reports, high GTAS scores, promotions, and the percent minority soldiers were generally associated with more negative perceptions of the unit. Based on these results, a worksheet was designed for use by company commanders in monitoring the status of key record data variables in their units.

SOCIAL PSYCHOLOGICAL AND INSTITUTIONAL CORRELATES OF UNIT EFFECTIVENESS

BRIEF

Requirement :

1) To apply a systems approach to the analysis of Army personnel system problems at the company level.

2) Development of a unit personnel management monitoring system, based on the results of the analysis above.

Procedure :

Survey and record data measures of a broad range of variables were collected from 60 combat line companies. Data were collected at three consecutive points in time, approximately two months apart. Factor and item analyses were used to identify the primary company-level sources of variance in the survey data and to develop measures of them. The resulting measures were used as basic components in a system model. Inter-relationships between the model components were determined by examining the correlations between them. To integrate the record data indicators into the model, correlations were calculated between record data variables and survey measures. Record data variables showing significant correlations with the survey measures were included in the final model. The relationships depicted in the resulting model were used to develop a prototype unit personnel management monitoring system.

Findings :

Factor and item analyses of the survey data resulted in seven perceptual model components. They were Leadership Climate, Leader Strictness, Enlisted Cohesion, Enlisted Commitment, Racial Climate, Moral Climate, and Unit Effectiveness. Almost all of the possible inter-correlations between these seven components were significant, indicating that the concepts represented in the model are highly inter-related, possibly because of some underlying affect variable such as general satisfaction or dissatisfaction with the unit.

With record data indicators were correlated with the perceptual measures, a number of significant relationships were found. The stongest of these was a positive effect of officer experience. That is, the longer a unit's officers had been in the service, the more positive the perceptions of the unit were. Other positive effects on the unit were NCO experience, awards and commendations, and enlisted turbulence. On the other hand, officer turbulence had a negative impact on perceptions of the unit, as did Article 15s, AWOLs, MP reports, high GTAS scores, promotions, and the percent minority soldiers.

Two approaches were examined for the monitoring system. The first used a small survey developed from a subset of the items used in the system modeling, and the second involved monitoring key record data variables. After examination of the two approaches, the survey approach was rejected because of the level of user effort required. Consequently, the record data approach was selected and a worksheet was designed to assist commanders in monitoring their Article 15s, MP reports, AWOLs, and promotions, all of which were found to be secondary indicators of unit effectiveness in the system modeling.

Utilization:

The findings of this study could be utilized at two different levels. The findings on turbulence, GTAS scores, and officer experience may be of interest to policy analysts. They raise some interesting questions about a number of current or anticipated Army policies, although because of the small sample size and general nature of this study, these findings should be treated as suggestive rather than definitive. The findings on Article 15s, AWOLs, and MP reports could be useful to unit commanders in performing their leadership and personnel management tasks. The reports contains a prototype work sheet which unit commanders can use to monitor these key variables in their units.

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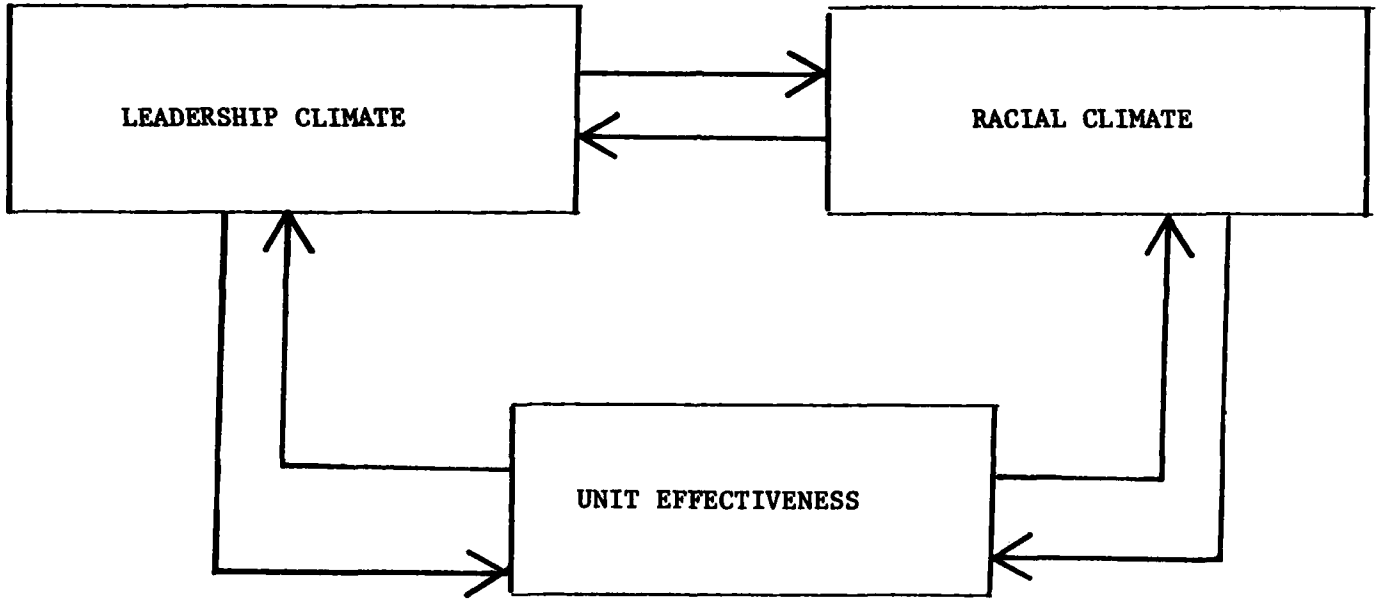
Social Psychological and Institutional Correlates of Unit Effectiveness

This report presents an extended analysis of data collected during a previous effort, which was designed to investigate the impact of racial harmony and leadership on unit effectiveness at the company level (Griesemer, Note 1). For this earlier project (which is referred to as Task A), survey and record data measures of racial harmony, leadership, and unit effectiveness were collected from 60 combat line companies at three consecutive points in time approximately two months apart. These data were used to investigate the fairly simple model of unit effectiveness shown in Figure 1, which relates the three concepts of leadership, racial harmony, and unit effectiveness.

While this simple model was adequate for the purpose of the original study (which was to investigate causal relationships between racial harmony and unit effectiveness, and between leadership, racial harmony, and unit effectiveness), it undoubtedly represents a substantial simplification of the complex social dynamics which operate in an Army company. One of the purposes of the present study is to develop a more sophisticated model of the social psychological determinants of unit effectiveness than was used in the previous study. This goal was approached by: 1) examining a number of variables not included in the first study, including a number of institutional impact variables derived from the record data; 2) re-defining some previously used variables based on empirical rather than *a priori* considerations; and 3) using an approach to cross-lagged panel analysis which was different from the Kenny (1973,1975) model used in the Task A study.

Figure 1. Model of Unit Effectiveness impacts investigated in Task A (Griesemer, Note 1).



A second purpose of the present study was to use the resulting unit effectiveness model to develop hypotheses relevant to a unit effectiveness monitoring system. The purpose of such a system would be to allow unit commanders to assess the state of personnel system variables in their units and identify potential problem areas which may impact on unit effectiveness.

The remainder of this report is divided into two major sections. The first section entitled "System Modeling", describes the effort to build a model of social psychological and institutional impacts on unit effectiveness. The second section, "Unit Personnel Management Monitoring System", describes an attempt to develop an application of the system model which could be useful in a field setting for improving unit effectiveness.

SYSTEM MODELING

The primary goal of the system modeling effort was to construct a model of how group personnel processes contribute to unit effectiveness in Army infantry companies. An additional goal was to examine the role of institutional impacts on unit effectiveness.

Method

Sample

The sample consisted of 60 combat line companies drawn from two divisions located in the continental United States, with 30 units selected from each of the two divisions. A sample of personnel from each of the units completed a survey questionnaire at three consecutive points in time, 10 weeks apart. For each time wave, a racially stratified random sample of 18 enlisted soldiers (grades E1-E4) was surveyed from each of the companies under study. The first sergeant and company commander of each company were also surveyed. This procedure resulted in a total sample of 3548 subjects.

Design and Procedure

A three wave panel design was used for this study. The three waves consisted of three consecutive 10-week measurement periods during which survey and record data were collected from each of the 60 companies in the sample. Record data were accumulated continuously throughout the study and then aggregated across the appropriate time period to form measures for each wave. During the final 2 weeks of each wave, survey data were obtained by means of a questionnaire which requested respondents to answer retrospectively for the past 8 weeks.

Survey Instrument. The survey instrument contained several hundred items consisting of statements relating to aspects of unit effectiveness, leadership, and race relations, followed by Likert-type response scales. Some of the

survey items were newly constructed for the Task A study while others were adapted from previous studies. For example, the survey used a number of leadership and organizational effectiveness items from the Survey of Organizations (Taylor & Bowers, 1972) and leadership items from an adaptation of the Leader Behavior Description Questionnaire used by Worchel, Sgro, and Cravens (Note 2). Also included were unit effectiveness items from Bauer, Stout, and Holz (Note 3), and Hart (1978, and Note 4). Finally, racial climate items were included from Hiett, McBride, and Fiman (the RAPS questionnaire, Note 5), and from Boyd & Griesemer (Note 6).

Record Data Collection. In addition to the survey data, a number of record data measures were collected for each company. These measures included counts of Article 15s, Awards, MP Reports, AWOLs, Unprogrammed Discharges, Sick Calls, Unit Status Reports, and monthly dumps of SIDPERS computerized personnel files and SIDPERS input transactions. For a more complete description of the record data collection procedures, the survey instrument, and the sampling procedures, see Griesemer (Note 1).

Development of the Model. In order to build on the results of the Task A study, it was decided to re-use 16 of the scales and seven of the record data measures which had been developed previously. These measures are shown in Table 1, grouped according to their placement in the Task A model. Also, it was decided to include several new scales which were developed during the present effort. These new scales were developed from a previously unanalyzed pool of items which dealt with peer group interactions among the E1-E4s and with a number of organizational factors. These areas were of interest because they correspond to variables which have been included in other studies of organizational effectiveness (eg., Taylor & Bowers, 1972). Finally, a number of new record data measures, primarily from SIDPERS personnel files were also of interest.

Table 1

Names of Survey and Record Data Measures Used in the Task A Model

	Measure	
Model Component	Survey Scale	Record Data
Unit Effectiveness	- Discipline - Cohesion - Preparedness to Fight - Unit Leadership Rating - Lawbreaking - Marijuana Use - Insubordination	- MP Reports - AWOLs - Sick Calls - Unit Status Reports
Leadership Climate	- Leader Fairness & Consideration - Leader Sacrifice - Leader Strictness - Leader Consultation Behaviors - Leader Problem Strategies	- Awards & Commendations - Unprogrammed Discharges - Article 15s
Racial Climate	- Overall Racial Climate - Overt Racial Hostility - Attitudes Toward Integration - Racial Solidarity	None

Note: For a detailed discussion of the development of these scales see Griesemer (Note 1).

Because the data base to be used in the study consisted of only 60 companies, there was a substantial restriction on the number of degrees of freedom available for constructing a model. Since there were so many variables of interest in the study, a number of steps were taken to keep the number of variables in the analysis consistent with the number of cases in the data base. One technique involved using factor and item analyses to identify individual survey measures which could be combined to form more global variables. The resulting "macro scales" were then used in the model building process in place of the original scales. The factor analyses not only served as a data reduction technique, but also served to define the content of the major components in the model. This made it possible to avoid the a priori assignment of scales to components in the model as was done in Task A.

The second technique, used to avoid introducing too many variables into the analysis at any one time, involved breaking the analysis into phases. Each phase involved the gradual introduction of new variables into the model as the role of the previously entered variables was determined. In the first phase, the new survey scales from Task A were factor analyzed. In the second phase, the new survey scales relating to peer group and organizational variables were developed from their respective item pools. Third, a factor analysis was conducted to integrate the new scales with the Task A scales. Fourth, the macro scales developed above were used to compute a cross-lagged panel correlation matrix which formed a preliminary system model. Finally, to complete the system model, correlation coefficients were computed between the record data measures and the macro scales. Generally, the record data measures were not factor analyzed to form macro measures because the intercorrelations among the individual record data variables were rather low. Instead, to reduce the number of concepts in the model, the record data measures were

placed a priori into logically connected groupings. Conclusions were based on the results of the variables in the group as a whole.

Correlational Analysis. Relationships between model components were identified using Pearson product-moment correlation coefficients. Since the design of this study provided data in the form of a three-wave time series, cross-lagged panel analysis could have been used, as it was in Task A, to attempt to identify causal relationships between the variables. However, for reasons discussed in the Appendix cross-lagged panel analysis was not used in the present study.

As an alternative to cross-lagged panel analysis, the present study simply analyzed cross-lagged correlations by focusing on their predictive value much as would be done in a conventional single time study. However, as the cross-lagged correlation matrix in Figure 2 shows, each cross-lagged comparison between two variables (X and Y) in a three wave design, produces 15 individual correlation coefficients. In order to statistically test the hypothesis that the two variables used to form a cross-lagged matrix are related, a technique was used which allows one to test any hypothesis about a correlation matrix that states that some of its elements are equal to each other and/or equal to specific numerical values (Steiger, 1980). An hypothesis of this type is called a pattern hypothesis. The null pattern hypothesis used in the present study (which is shown in the lower half of Figure 2), specifies that all of the synchronous and cross-lagged correlations in the matrix are equal to zero. The autocorrelations in the matrix are allowed to "float" and are not directly involved in the hypothesis test. The pattern hypothesis test produces a single chi squared value for rejection of the null hypothesis, and thus, is conceptually similar to the overall F computed in analysis of

Figure 2. Correlation matrix for a two variable (X & Y), 3 wave panel study. The type of each correlation coefficient is shown above the diagonal. The pattern hypothesis for testing the null hypothesis that the synchronous and cross-lagged correlations equal zero is shown below the diagonal.

	X_1	X_2	X_3	Y_1	Y_2	Y_3
X_1	——	X Auto Lag=1	X Auto Lag=2	Synchronous Lag=0	Cross w/X Leading Lag=1	Cross w/Y Leading Lag=2
X_2	F	——	X Auto Lag=1	Cross w/Y Leading Lag=1	Synchronous Lag=0	Cross w/X Leading Lag=1
X_3	F	F	——	Cross w/Y Leading Lag=2	Cross w/X Leading Lag=1	Synchronous Lag=0
Y_1	0	0	0	——	Y Auto Lag=1	Y Auto Lag=2
Y_2	0	0	0	F	——	Y Auto Lag=1
Y_3	0	0	0	F	F	——

Note: An "F" in this pattern hypothesis indicates that the correlation in that position is allowed to float and is not directly involved in the hypothesis test. A zero indicates that the correlation is specified to be equal to zero.

variance. This procedure allowed a single test of all of the correlations in the matrix which directly relate X and Y. If the chi squared value from the pattern hypothesis test was not large enough to allow rejection of the null hypothesis that the synchronous and cross-lagged correlations were equal to zero, the conclusion was drawn that the two variables involved in the cross-lagged comparison were not related across the time interval used in the study.

Tables in this report, which present the results of cross-lagged comparisons, were simplified by averaging correlation coefficients with equal time lags in the same way as was done in the simulation presented in the Appendix.* That is, the synchronous correlations were averaged, as well as the two correlations across one wave with X leading and the two correlations across one wave with Y leading. The two cross-lagged correlations across two waves (one with X leading and one with Y leading) are unique, and therefore, were presented individually. This reduces the number of correlations which must be presented from nine correlations to five, and produced more stable estimates of the true values of the synchronous and one wave cross-lagged correlations.

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* Although averaging correlation coefficients is not strictly correct the distortion it produces in coefficients of the size found in this report is quite small (only two or three hundreths of a point for the largest correlations, less for the smaller ones). Therefore averaging was used instead of more complex transformations because of its conceptual and computational simplicity.

Results

Factor and Item Analysis of Task A Scales

As a first step in the development of macro scales, the 16 company level scale scores from Task A (which are shown in Table 1) were factor analyzed using an iterated principal axis method followed by promax rotation of factors with eigenvalues greater than one (SAS Institute, 1979 pp. 203-210). Promax rotation is an oblique rotation method which produces correlated rather than independent (orthogonal) factors. Oblique rotation was used because of the expectation that any factors which existed in the data would, in fact, be intercorrelated, making the constraint of orthogonality unrealistic. In order to make fullest use of the available data, the factor analysis was performed by concatenating the observations for the 60 companies across the three time waves. The resulting N was 177 (60 companies times 3 waves, less missing data).

The results of the factor analysis of the Task A scales are presented in Table 2. The table shows the factor pattern coefficients greater than .50 on each of the rotated factors. Pattern coefficients were used because in an oblique rotation they indicate the clustering of items more clearly than do structure coefficients. The composition of the first three factors is fairly clear. Factor 1 appears to be a racial climate factor with very high loadings on all four racial climate scales. Factor 2 appears to be a leadership climate factor consisting of the Unit Leadership Rating, the Leader Fairness & Consideration scale, and the Leader Sacrifice scale. Factor 3, containing the Lawbreaking, Insubordination, and Marijuana Use scales, was named "Moral Climate". The nature of the

Table 2

Factor Pattern Coefficients Greater than .50 From Factor Analyses of Task A Scales

Macro Scale Designation (if any)	Scale Name	Factor 1	2	3	4
Racial Climate	Overall Racial Climate	.83			
	Overt Racial Hostility	.73			
	Attitudes Toward Integration	.79			
	Racial Solidarity	.84			
Leadership Climate	Unit Leadership Rating		.84		
	Leader Fairness & Consideration		.87		
	Leader Sacrifice		.88		
-	Lawbreaking			-.63	
	Insubordination			-.59	
	Marijuana Use			-.55	
-	Cohesion				-.82
	Leader Strictness				-.56
-	Discipline				
	Preparedness to Fight		- None -		
	Leader Consultation Behaviors				
	Leader Problem Strategies				

fourth and final factor is somewhat less clear than that of the first three factors. Factor 4 is made of the Cohesion scale with a pattern coefficient of -.82 and the Leader Strictness scale with a much lower coefficient of -.56. This factor is difficult to explain because the item content of these two scales is so different that it is not easy to conceive of them as measures of the same underlying construct.

To evaluate the four factors as possible macro scales, four alpha reliability coefficients were calculated using the scales which loaded highly on each of the four factors. Macro scale scores were calculated by summing the standardized scores from the individual component scales. The macro scales formed from the first two factors, Racial Climate and Leadership, both exhibited alphas of .88 which was considered high enough for them to be used as macro scales. Consequently, their component scales were removed from subsequent factor and item analyses. The other two factors, Moral Climate and Cohesion/Strictness, exhibited relatively weak alphas (.69 and .62 respectively), and were not designated as macro scales at this point in the analysis.

Development of Enlisted Commitment and Organizational Scales

The Taylor and Bowers (1972) model of organizational effectiveness, upon which the Survey of Organizations (SOO) was based, contains a number of components which seemed relevant to the concept of unit effectiveness and which had not been included in the Task A model. These concepts included peer group leadership, organizational climate, and group processes. An attempt was made to include these concepts in the present study by developing a set of survey scales from a pool of questionnaire

items which had not been analyzed in Task A. These items had some resemblance to items which comprised the original Taylor and Bowers concepts and, in fact, a few of the items had been taken almost directly from Taylor and Bowers.

To develop these new scales, the relevant survey items were divided into two separate item pools and factor analyzed. One of these pools contained items which asked about the enlisted soldiers in the company, and correspond to the peer leadership and group processes concepts. Questions in the other item pool dealt with organizational aspects of the company or its platoons and correspond to the organizational climate dimension.

Separate factor analyses were conducted on each item pool. All individual responses to the survey across all three waves were used, resulting in an N of 3317. Individual data were used at this point in the analysis in order to provide compatability with the scale development procedures used in Task A. Factor loading and reliability criteria were lowered somewhat in this phase of the analysis since it was preliminary to the development of the actual macro scales. As before, an iterated principal axis factoring method was employed, and factors with eigenvalues greater than one were retained for promax rotation.

Table 3 presents the results of the factor analysis of the peer item pool. Items loading on Factor 1 generally have to do with hiding mistakes from leaders, but some items also deal with rule breaking and disrespect for leaders. Taken together these things seem to represent a situation in which the enlisted soldiers have turned away from their leaders and their peers, and are primarily looking out for their own

Table 3

Peer Group Item Pool and Factor Patterns

Coefficients $\geq$ .40 on Rotated Factors

Scale Designation (if any)	Item Description	Factor 1	2	3	4	5	6
EM Polarization	- EMs hide mistakes from company leaders [a]	.48					
	- EMs cover up problems [a]	.57					
	- EMs lend money for a high rate of interest [a]	.44					
	- EMs insult chain of command [a]	.45					
	- EMs inform on each other [a]	.42					
	- EM disliked if he informs [a]	.42					
	- EMs encourage each other to break rules [a]	.53					
EM Consideration	- EMs friendly and easy to approach		.58				
	- Other EMs pay attention to what I say		.61				
	- Other EMs willing to listen to my problems		.45				
	- EMs treat all group members as equals		.41				
EM Agreement	- EMs agree with rules they are asked to live by			-.79			
	- EMs agree with leaders about right & wrong			-.80			

Table 3 - continued

Peer Group Item Pool and Factor Pattern

Coefficients $\geq$ .40 on Rotated Factors

Scale Designation (if any)	Item Description	Factor 1	2	3	4	5	6
EM Goals	- Is your goal to make the company strong				.80		
	- Is the goal of the EMs to make the company strong				.56		
EM Production Emphasis	- EMs put pressure on members to work harder					.68	
	- EMs put pressure on members to do better work					.64	
	- EMs get angry at members not keeping up					.50	
-	- EMs can make wise choices without leaders						-.62
	- Do you trust EMs in unit to exercise good judgement						-.49
-	- EMs criticize members not working						
	- Everything runs smoothly when CO & 1SG are away			- None -			
	- EMs feel sorry for mistakes						
	- Do you follow a policy of making unit strong						
	- EMs keep information secret						

Table 3 - continued

Peer Group Item Pool and Factor Pattern

Coefficients $\geq$ .40 on Rotated Factors

Scale Designation (if any)	Item Description	Factor 1	2	3	4	5	6
-	- EMs follow same rules as leaders - EMs don't mind receiving Article 15s			- None -			

a. Item scoring reversed when calculating the scale scores.

interests. Consequently, this factor was named EM Polarization. Unlike the other scales discussed so far, the scoring of the items in the EM Polarization scale was such that a numerically high score represented negative conditions in the unit. Since all the scales from Task A had been scored such that a high score represented a positive condition, the scoring of EM Polarization was reversed so that it would conform to the Task A convention.

Factor 2 was somewhat the opposite of Factor 1. The highly loading items on this factor all related to positive interactions between the enlisted soldiers. It was named EM Consideration and it roughly corresponds to the SOO Peer Support dimension. Factor 3 contains two items both of which relate to the extent to which enlisted soldiers agree with their leaders and was called EM agreement. The fourth factor was named EM goals because the two items loading on it ask whether the EM's goal is to make the company strong. Factor 5 contained those items related to the extent to which EMs encourage each other to work harder. This factor corresponds to the SOO Peer Work Facilitation dimension (although the actual items were taken from an LBDQ scale called "Production Emphasis"). Finally, the items loading on Factor 6 concern the extent to which enlisted soldiers exercised good judgement. This factor was named EM responsibility.

The reliability of the scales formed from the peer item pool was rather low, being .67, .65, .75, .66, .60, and .54 for Factors 1-6, respectively. However all but Factor 6 were retained in the analyses in order to examine the possibility that the individual scales might combine to form a macro scale with a higher reliability.

Results of the factor analysis of the organizational climate item pool are presented in Table 4. In this factor analysis, two factors met the criterion for rotation. The first factor contains items which are primarily related to the performance of the unit as a whole. The first two items in the factor come from the SOO Technological Readiness dimension which is a subscale of Organizational Climate. The other two items relate to how well the members of the unit plan together and make good decisions. This factor was named Unit Organization and had an alpha of .77. Items in the second factor dealt with disorganization and conflict in the company. However, its alpha was only .59 and it was not retained for further analysis.

Table 4

Organizational Item Pool Factor Pattern of

Coefficients Loading $\geq$ .40 on Rotated Factors

Scale Designation (if any)	Item Description	Factor 1	Factor 2
Unit Organization	- Company quick to use improved work methods	-.61	
	- Company equipment & resources adequate and well maintained	-.47	
	- Does company plan together and coordinate efforts	-.76	
	- Does company make good decisions	-.80	
-	- Everyone gets in each other's way		.48
	- Platoons/sections are in conflict with company		.71
	- Leader priorities not related to unit effectiveness		.44
-	- How often are goals & policies changed	- None -	
	- Conflict between platoons		

Integration of New Scales and Task A Scales

The next step in the analysis was to determine if additional company level macro scales could be formed from the remaining Task A scales and the newly developed peer group and organizational scales. To do this a third factor analysis was conducted using the company level scale scores from the new scales and the remaining Task A scales which had not already been used to form the leadership and racial climate macro scales. The resulting factor pattern coefficients greater than .50 are presented in Table 5.

The first factor shown in the table has four highly loading scales, EM Polarization, Insubordination, Lawbreaking, and Marijuana Use. Because all four of these scales deal with the incidence of various illegal activities, acts of disrespect, and other anti-social behavior, the Moral Climate name, used previously for the latter three scales, was retained. When the scales loading on Factor 1 were used to form a macro scale, an alpha reliability of .80 was obtained, which was considered high enough to justify retention in subsequent analyses.

The second factor contained two highly loading items, Cohesion and Leader Strictness. As was stated when this factor appeared in the first factor analysis of the Task A scales, these two scales contain such different item content that it is difficult to conceive that they are measures of the same underlying construct. In fact, these two scales form a rather poor macro scale with a reliability of only .62. Rather, it seems more reasonable that Leader Strictness and EM Cohesion are two different variables which are related either causally or spuriously. Therefore, these two scales were used independently as components in the system model.

Factor 3 consisted of the three new enlisted peer group scales, Em Agreement, EM Goals, and EM Production Emphasis. If a company scored high on the

Table 5

Factor Pattern Coefficients $\geq$ .50 From Factor Analysis

of New Scales and Remaining Task A Scales

Macro Scale Designation (if any)	Item Description	Factor 1	2	3	4
Moral Climate	EM Polarization	.63			
	Insubordination	.55			
	Lawbreaking	.57			
	Marijuana Use	.59			
-	Cohesion		-.81		
	Leader Strictness		-.60		
EM Commitment	EM Agreement			-.51	
	EM Goals			-.90	
	EM Production Emphasis			-.59	
Unit Effectiveness	Unit Organization				.76
	Preparedness to Fight				.66
	Discipline				.59
-	EM Consideration				
	Leader Consultation Strategies		- None -		
	Leader Problem Strategies				

factor, it would represent a situation where the enlisted soldiers were committed to the company and its leaders, and working to make the company effective; consequently, this factor was named Enlisted (EM) Commitment. When these items were used as a macro scale, a reliability of .73 was obtained which was considered adequate for subsequent use.

The fourth and final factor extracted in the factor analysis consisted of the new Unit Organization scale, the Preparedness to Fight scale, and the Discipline scale. Used together as a macro scale these measures exhibited a reliability of .81. This macro scale was named Unit Effectiveness because it includes many items which are commonly mentioned as face valid indicators of unit performance.

Summary of Macro Scale Development

The four factor analyses presented above resulted in seven macro scales which were included in the initial system model. They were: Leadership Climate; Leader Strictness; Racial Climate; EM Commitment; Moral Climate; and Unit Effectiveness. The final macro scales and their individual component scales are summarized in Table 6.

Preliminary System Model

The first step in developing the system model was to examine the intercorrelations between the macro scales. As explained in the method section, unit level macro scale scores were used to compute a matrix of cross-lagged comparisons. Since each cross-lagged comparison involves nine X/Y correlations, the significance test used in this analysis was a test of the null pattern hypothesis that the synchronous and cross-lagged correlations equal zero. Table 7 shows the probability of rejection of the null pattern hypothesis (Steiger, 1980) for each of the comparisons between the macro scales. Probabilities greater than .05 are not shown. It is obvious from Table 7 that

Table 6

Final Macro Scales and Their Individual Component Scales

Macro Scale Name	Alpha	Component Scales	Scale Origin[a]
Leadership Climate	.88	- Leader Fairness	Task A
		- Leader Sacrifice	Task A
		- Unit Leadership Rating	Task A
Leader Strictness		None	Task A
Racial Climate	.88	- Overall Racial Climate	Task A
		- Attitudes Toward Integration	Task A
		- Racial Solidarity	Task A
		- Overt Racial Hostility	Task A
EM Commitment	.73	- EM Agreement	Peer Item Pool
		- EM Goals	Peer Item Pool
		- EM Production Emphasis	Peer Item Pool
EM Cohesion		None	Task A
Moral Climate	.80	- Insubordination	Task A
		- Lawbreaking	Task A
		- Marijuana Use	Task A
		- EM Polarization	Peer Item Pool
Unit Effectiveness	.81	- Discipline	Task A
		- Preparedness to Fight	Task A
		- Unit Organization	Organizational Item Pool

a. Item content of scales from the Peer Item Pool and Organizational Item Pool can be found in Tables 3 and 4 respectively.

Table 7

Probabilities for Rejection of the Pattern Hypothesis That the Synchronous and Cross-Lagged Correlations Equal Zero for Cross-Lagged Comparisons Between the Macro Scales[a]

	Leadership Climate	Leader Strictness	Racial Climate	EM Commitment	Moral Climate	EM Cohesion	Unit Effectiveness
Leadership Climate	-		.003	.001	.001		.001
Leader Strictness		-	.001			.001	
Racial Climate			-	.001	.001	.001	.001
EM Commitment				-	.001	.025	.001
Moral Climate					-		.001
EM Cohesion						-	.001
Unit Effectiveness							-

a. The pattern hypothesis tested is shown in Figure 8.5.

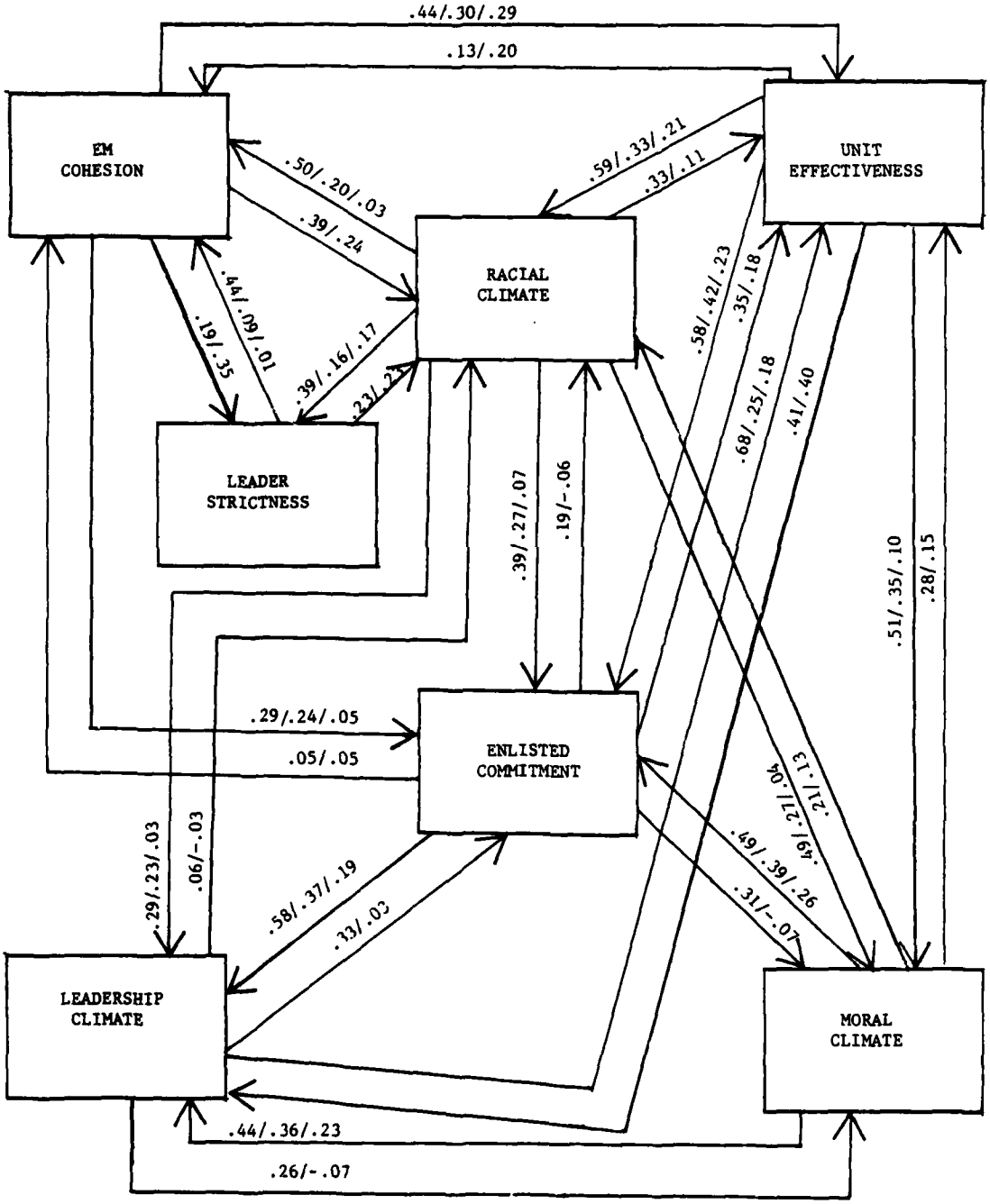
there are a large number of significant correlations between the macro scales. In fact, the only comparisons which were non-significant involved the two measures which were not actually macro scales, Leader Strictness and EM Cohesion.

The actual average synchronous and cross-time correlations for significant comparisons between the model components are shown graphically in Figure 3. In Figure 3 there are three numbers above each upper arrow, and two above each lower arrow. These numbers represent correlation coefficients that have been averaged in the manner discussed previously in the methods section (p. 11). The average synchronous correlation is the left most number on the upper path arrow; the next two numbers to the right, one above each arrow, are the average cross-lagged correlations. The two right most numbers are the individual cross-lagged correlations across two waves. The direction of the arrows indicate the time precedence for the cross-lagged correlations above them, with the arrow pointing away from the variable measured first in time. The figure shows that the correlations are almost universally positive and, in some cases, fairly high.

Developing a system model out of the correlations presented in Figure 3 is not a straight-forward task. The traditional approach would be to use path analysis. However, the large number of paths required to represent such highly intercorrelated data would produce a model which is hopelessly under identified. Estimation of such a model would produce totally meaningless path coefficients. Two approaches were considered to solve the under identification problem. One was to introduce additional exogenous variables, which unfortunately were not available in sufficient numbers in this case. The other was to simplify the model by deleting some of the paths.

One criterion which was considered for deleting paths in the model was that of significant cross-time correlations. An individual correlation

Figure 3. Paths required to represent significant correlations between perceptual system model components.



must be greater than or equal to .25 to be significantly different from zero at the .05 level (two tailed). If this criterion were applied to the average correlations in Figure 3, then all of the synchronous correlations would reach the .05 significance level, while a number of cross-time correlations would not. For example, there were no significant cross-time correlations on the path leading from EM Committment to Racial Climate. Several other variable pairs had no significant cross-time correlations in either direction, for example; EM Cohesion and EM Committment, or Leadership Climate and Racial Climate. However, as the discussion on cross-lagged panel analysis in the Appendix indicates, the small magnitude of these cross-time correlations may simply be due to a lack of correspondence between the causal interval and the measurement interval. The significant synchronous correlations and the perceptual nature of these variables suggests that the causal intervals of these relationships may well be shorter than the ten-week measurement interval used in this study. Consequently, it was decided that lack of significant cross-time correlations could not be used as a criterion for deleting paths in the model.

Another possibility which was examined, was deleting all but the direct paths leading to Unit Effectiveness. The rationale for this manipulation was that unit effectiveness was the one concept which was the most important to predict because of the face validity of its scales. However, rearranging the model in this arbitrary manner would be a gross over-simplification of the high degree of intercorrelation between various model components which is one of the chief features of these data.

The solution to these problems was to simply leave the model in the form shown in Figure 3, which uses the pattern hypothesis test to identify paths between the variables. The relative strength of the paths and their

ability to predict the model components over time can be judged from the synchronous and cross-time correlations shown on the paths. While this presentation does not allow a direct estimate of the variance accounted for by the relationship between two variables, as path analysis would, it does at least, present the inter-relationships themselves accurately.

One thing which is interesting, and perhaps useful, about the correlations in Figure 3 is that they indicate that a substantial portion of the variance in perceptions of unit effectiveness can be accounted for across a time span of over two months by concepts such as Racial Climate, EM Cohesion, and EM Commitment. This means that a commander can receive early warning of potential problems in unit effectiveness by monitoring these variables. In addition, the correlations indicate that concepts represented in the model are interrelated to such an extent that it can be expected that a substantial change in any of them will be followed by a change in the others. The implications of this finding for unit leadership seem to be that a problem which develops in one of these areas cannot be dealt with in isolation. For example, a racial problem cannot be viewed as just a racial problem because it may, in fact, be symptomatic of other problems in the unit, or it may be a harbinger of other problems which have yet to manifest themselves.

Another point of interest in Figure 3 is the relationship between Leadership Climate and Unit Effectiveness. Many studies have used items such as those found in the Leader Fairness & Consideration component of the Leadership Climate measure, in order to identify characteristics of successful leaders. The implied goal of these studies was to develop information which could be used to identify individuals who might become suc-

cessful leaders. The data in Figure 3 show that there was a strong synchronous correlation of .68 between the Leadership Climate and Unit Effectiveness, also that the cross-lagged correlations with Unit Effectiveness measured first in time were rather high (.41, lag=1; and .40, lag=2), confirming that these items do identify perceived characteristics of leaders from successful units. However, the cross-lagged correlations going in the other direction (i.e., from leadership characteristics to Unit Effectiveness) are much lower (.25, lag=1; and .18, lag=2). The same pattern can be seen in the other measures related to Leadership Climate, although to a lesser extent. These variables (EM Commitment, Moral Climate, and Racial Climate) always predict Leadership Climate across time better than Leadership Climate predicts them. This finding casts some doubt on the utility of using perceived leader characteristics to predict effectiveness, and suggests that perceptions of leadership climate might best be viewed as a result of unit effectiveness rather than a cause.

Integration of Record Data Measures into the System Model

The next step in the analysis was to integrate record data variables into the preliminary system model created from the macro scales. In order to do this, the various types of record data that were collected were examined to identify a set of measures which seemed relevant to the concept of unit effectiveness and had suitable distributional properties for statistical analysis. Many of the variables examined (such as Bars to Re-enlistment and Courts-Martial) had very low frequency counts resulting in highly skewed distributions and many scores of zero which made them unusable. The result of this screening process was a set of 31 record data measures, grouped into nine content categories as shown in Table 8. Cross-lagged

Table 8

Probabilities for Rejection of the Pattern Hypothesis that the Synchronous and Cross-Lagged Correlations Equal Zero for Comparisons Between the Record Data Measures and Macro Scales

Record Data	Macro Scales						
Category & Variable	Leadership Climate	Leader Strictness	Racial Climate	EM Commitment	Moral Climate	EM Cohesion	Unit Effectiveness
Record Data UE Indicators							
Military Police Reports			.007		.075		.077
AWOLs					.039	.079	.086
Re-Enlistments							
Sick Calls							
USR I(Strength)							
USR II(Logistics)							
Leader Punishments							
Article 15s	.046			.016	.079		.059
Unprogrammed Discharges	.019	.046		.099			
Leader Rewards							
Awards & Commendations							.062
Promotions(E3-E5)			.010				
Enlisted Turbulence							
Arrivals					.025		
Departures							
Average Time in Unit(E1-E4)	.007			.009	.082		.055
Total Turbulence (Arrivals + Departures)							

Table 8 - Continued

Probabilities for Rejection of the Pattern Hypothesis that the Synchronous and Cross-Lagged Correlations Equal Zero for Comparisons Bewteen the Record Data Measures and Macro Scales

Record Data	Macro Scales						
Category & Variable	Leadership Climate	Leader Strictness	Racial Climate	EM Commitment	Moral Climate	EM Cohesion	Unit Effectiveness
Officer & NCO Turbulence							
Average Time in Unit(01-03)	.006		.065		.082		.005
Average Time in Unit(E5-E9)							
Officer Experience & Education							
Years Civilian Education(01-03)							.033
Highest Military Education(01-03)	.053		.048	.026	.023		.003
Average Time in Service(01-03)	.001		.021	.068	.028	.073	.002
Average Time in Grade(01-03)	.029			.071	.088		.020
NCO Experience & Education							
Years Civilian Education(E5-E9)							
NCO Education(E5-E9)							
Average Time in Service(E5-E9)			.062				
Average Time in Grade(E5-E9)			.085			.079	
Enlisted Education & Experience							
Years Civilian Education(E1-E4)							
Average GTAS Score(E1-E4)	.061			.001		.028	
Average Time in Service(E1-E4)		.096					
Racial Variables							
Percent Minority						.098	
Discrimination Indicator [a] (Promotions)			.066			.056	
Discriminations Indicator [a] (AR15s)	.067		.076		.075		.055

a. Since discrimination indicators calculated on small samples are inherently unreliable (Goehring, Note 7), data for this measure was aggregated across the entire 30 weeks of the study and a single correlation coefficient calculated using the wave 3 survey data. Therefore, the probabilities shown are for the T test of the null hypothesis that this single correlation coefficient equals zero.

comparisons were then computed between the various record data measures and the macro scales. For each of these comparisons, Table 8 presents the probabilities for rejection of the null hypothesis that the synchronous and cross-lagged correlations are equal to zero. In an earlier study which correlated perceptual measures with record data variables (Boyd & Griesemer, Note 6), significant correlations were found which averaged approximately .20 in a sample of 113 companies. In order for the present analysis to be sensitive to correlations of that size with a sample of only 60 companies, an alpha level of .10 was used as the significance criterion in Table 8.

One very basic question which can be addressed using the data in Table 8 is the validity of the perceptual macro measures. In order to be considered valid indicators of actual unit conditions, the macro scales should correlate with other measures of unit conditions which are obtained using different methods, such as record data variables. In Table 8 there are 210 possible correlations between the macro scales and the record data measures. Of these, 54 or 26% are significant beyond the .10 level, which is more than double the number of significant relationships which would be expected by chance. This finding supports the validity of the macro scales.

In order to identify the direction of the various relationships identified in Table 8, the average cross-lagged and synchronous correlations were examined. These correlations are presented in Table 9 and are discussed below by record data variable category.

Record data unit effectiveness measures. There were six record data variables placed in this category. They were: number of Military Police (MP) reports; number of AWOLs; number of re-enlistments; number of sick calls; and two composite variables generated from special Unit Status Re-

Table 9

Synchronous and Cross-Lagged Correlations for Significant Comparisons Between Record Data Measures and Macro Scales[a]

Record Data Measures (X)	Macro Scale (Y)	Average Synchronous Correlations Lag=0		Cross-lagged Correlations Lag=1	Cross-lagged Correlations Lag=2
Record Data Unit Effectiveness Indicators					
MP Reports	Racial Climate	-.10	X Leading	-.21	-.41
			Y Leading	-.14	-.06
	Moral Climate	-.04	X Leading	-.07	-.29
			Y Leading	-.16	.04
	Unit Effectiveness	-.02	X Leading	-.14	-.35
			Y Leading	-.08	.05
AWOLS	Moral Climate	-.07	X Leading	-.00	-.05
			Y Leading	-.27	.12
	EM Cohesion	-.00	X Leading	-.24	-.17
			Y Leading	-.02	.04
	Unit Effectiveness	-.11	X Leading	-.10	-.19
			Y Leading	-.27	-.01

Table 9 - Continued

Synchronous and Cross-Lagged Correlations for Significant Comparisons Between Record Data Measures and Macro Scales[a]

Record Data Measures (X)	Macro Scales (Y)	Average Synchronous Correlations Lag=0		Cross-Lagged Correlations Lag=1	Cross-Lagged Correlations Lag=2
Leader Punishments					
Article 15s	Leadership Climate	-.15	X Leading	-.16	-.32
			Y Leading	-.04	-.30
	EM Commitment	-.13	X Leading	-.26	-.27
			Y Leading	-.01	-.05
	Moral Climate	-.11	X Leading	-.24	-.23
			Y Leading	-.12	-.12
	Unit Effectiveness	-.14	X Leading	-.19	-.35
			Y Leading	.01	-.11
Unprogrammed Discharges	Leadership Climate	-.10	X Leading	-.05	-.18
			Y Leading	-.28	-.21
	Leader Strictness	.06	X Leading	-.10	.26
			Y Leading	.04	.32
	EM Commitment	-.15	X Leading	-.04	-.31
			Y Leading	-.17	-.13

Table 9 - Continued

Synchronous and Cross-Lagged Correlations for Significant Comparisons Between Record Data Measures and Macro Scales[a]

Record Data Measures (X)	Macro Scales (Y)	Average Synchronous Correlations Lag=0		Cross-Lagged Correlations Lag=1	Lag=2
Leader Rewards					
Awards & Commendations	Unit Effectiveness	.21	X Leading	.17	-.14
			Y Leading	.21	.17
Promotions	Racial Climate	.07	X Leading	-.13	-.32
			Y Leading	.05	.29
Enlisted Turbulence					
Arrivals	Moral Climate	.15	X Leading	.14	-.06
			Y Leading	.09	.01
Time in Unit (E1-E4)	Leadership Climate	-.26	X Leading	-.16	-.07
			Y Leading	-.25	-.05
	EM Commitment	-.25	X Leading	-.08	.04
			Y Leading	-.13	.11
	Moral Climate	-.20	X Leading	-.11	.06
			Y Leading	-.23	-.08
	Unit Effectiveness	-.17	X Leading	-.02	.10
			Y Leading	-.10	-.05

Table 9 - Continued

Synchronous and Cross-Lagged Correlations for Significant Comparisons Between Record Data Measures and Macro Scales[a]

Record Data Measures (X)	Macro Scales (Y)	Average Synchronous Correlations Lag=0		Cross-Lagged Correlations Lag=1	Cross-Lagged Correlations Lag=2
Officer & NCO Turbulence					
Time in Unit (01-03)	Leadership Climate	.14	X Leading	.23	.40
			Y Leading	.08	-.13
	Racial Climate	.21	X Leading	.25	.21
			Y Leading	.25	.08
	Moral Climate	.19	X Leading	.21	.33
			Y Leading	.07	-.11
	Unit Effectiveness	.22	X Leading	.23	.38
			Y Leading	.09	-.08
Officer Experience & Education					
Average Time in Service	Moral Climate	.28	X Leading	.29	.15
			Y Leading	.27	.19
	Cohesion	.30	X Leading	.29	.09
			Y Leading	.32	.27
	Unit Effectiveness	.35	X Leading	.39	.27
			Y Leading	.30	.31

Table 9 - Continued

Synchronous and Cross-Lagged Correlations for Significant Comparisons Between Record Data Measures and Macro Scales[a]

Record Data Measures (X)	Macro Scales (Y)	Average Synchronous Correlations Lag=0		Cross-Lagged Correlations Lag=1	Cross-Lagged Correlations Lag=2
Officer Experience & Education					
Average Time in Service (01-03)	Leadership Climate	.32	X Leading	.43	.43
			Y Leading	.21	.16
	Racial Climate	.28	X Leading	.31	.16
			Y Leading	.25	.26
	EM Commitment	.23	X Leading	.32	.28
			Y Leading	.18	.19
Average Time in Grade (01-03)	Leadership Climate	.36	X Leading	.26	.16
			Y Leading	.25	.14
	EM Commitment	.24	X Leading	.20	.25
			Y Leading	.11	.22
	Moral Climate	.18	X Leading	.16	.05
			Y Leading	.28	.22
	Unit Effectiveness	.35	X Leading	.29	.22
			Y Leading	.30	.27

Table 9 - Continued

Synchronous and Cross-Lagged Correlations for Significant Comparisons Between Record Data Measures and Macro Scales[a]

Record Data Measures (X)	Macro Scales (Y)	Average Synchronous Correlations Lag=0		Cross-Lagged Correlations Lag=1	Lag=2
		Officer Experience & Education			
Years Civilian Education (01-03)	Unit Effectiveness	.13	X Leading	.04	.00
			Y Leading	.25	.23
Highest Military Education Level (01-03)	Leadership Climate	.30	X Leading	.34	.29
			Y Leading	.22	.16
	Racial Climate	.10	X Leading	.04	-.11
			Y Leading	.12	.26
	EM Commitment	.18	X Leading	.28	.20
			Y Leading	.21	-.03
	Moral Climate	.27	X Leading	.27	.09
			Y Leading	.17	.13
	Unit Effectiveness	.24	X Leading	.23	.11
			Y Leading	.19	.25

Table 9 - Continued

Synchronous and Cross-Lagged Correlations for Significant Comparisons Between Record Data Measures and Macro Scales[a]

Record Data Measures (X)	Macro Scales (Y)	Average Synchronous Correlations Lag=0		Cross-Lagged Correlations Lag=1	Lag=2
NCO Experience & Education					
Average Time in Service (E5-E9)	Racial Climate	-.16	X Leading	.01	.16
			Y Leading	-.19	-.20
Average Time in Grade (E5-E9)	Racial Climate	-.12	X Leading	.05	.23
			Y Leading	-.13	-.14
	EM Cohesion	.04	X Leading	.21	.39
			Y Leading	-.00	-.11
Enlisted Education & Experience					
Average GTAS (E1-E4)	Leadersip Climate	-.19	X Leading	-.23	-.19
			Y Leading	-.07	.07
	EM Commitment	-.32	X Leading	-.30	-.13
			Y Leading	-.14	-.01
	EM Cohesion	.01	X Leading	-.04	-.26
			Y Leading	.23	.29

Table 9 - Continued

Synchronous and Cross-Lagged Correlations for Significant Comparisons Between Record Data Measures and Macro Scales[a]

Record Data Measures (X)	Macro Scales (Y)	Average Synchronous Correlations Lag=0		Cross-Lagged Correlations Lag=1	Lag=2
Enlisted Education & Experience					
Average Time in Service (E1-E4)	Leader Strictness	.12	X Leading	.10	.21
			Y Leading	.15	.22
Racial Variables					
Discrimination Indicator (Promotions)[b]	Racial Climate	.24	X Leading	-	-
			Y Leading	-	-
	EM Cohesion	.25	X Leading	-	-
			Y Leading	-	-
Discrimination Indicator (Article 15s)[b]	Leadership Climate	-.24	X Leading	-	-
			Y Leading	-	-
	Racial Climate	-.23	X Leading	-	-
			Y Leading	-	-
	Moral Climate	-.23	X Leading	-	-
			Y Leading	-	-
	Unit Effectiveness	-.25	X Leading	-	-
			Y Leading	-	-

Table 9 - Continued

Synchronous and Cross-Lagged Correlations for Significant Comparisons Between Record Data Measures and Macro Scales[a]

Record Data Measures (X)	Macro Scales (Y)	Average Synchronous Correlations Lag=0		Cross-Lagged Correlations Lag=1	Cross-Lagged Correlations Lag=2
			Racial Variables		
% Minority	EM Cohesion	-.16	X Leading	-.09	.15
			Y Leading	-.27	-.34

a. n = 59, $r \geq .25$ $p < .05$, $r \geq .33$ $p < .01$, two tailed.

b. Since discrimination indicators calculated on small samples are inherently unreliable (Goehring, Note 7), data for this measure was aggregated across the entire 30 weeks of the study and a single correlation coefficient calculated using the wave 3 survey data. Consequently, cross-lagged correlations could not be calculated.

port (USR) data which was gathered at the company level. In order to control for company size and the possibility that some record data measures would not be directly comparable across divisions because of differences in local administrative procedures, record data measures involving frequencies (in this case MP reports, AWOLs, re-enlistments, and sick calls) were residualized for the effect of company size and post.

The two USR composites were developed using factor and item analysis techniques similar to those used to develop the macro scales. The first composite (USR I) seems to represent a strength dimension and consists of six elements: the operating strength percentage; the MOS trained percentage; the deployable strength percentage; the availability of qualified leaders rating; the weeks to complete training; and the overall unit rating (see Dept. of the Army, Note 8, for more information on individual USR items). The alpha reliability for USR I was .80. USR II appears to represent a logistics dimension and consists of: the availability of training areas/facilities rating; the availability of fuel rating; the availability of time rating; and the availability of ammunition rating. USR II had an alpha coefficient of .72. Neither of these USR measures showed any significant correlation with the macro scales, nor did re-enlistments or sick calls. On the other hand, MP reports and AWOLs did show a number of significant relationships. As might be expected, most of these correlations (shown in Table 9) are negative, indicating that positive perceptions of unit conditions are associated with fewer MP reports and AWOLs.

An interesting characteristic of the significant MP report relationships is that the highest correlations occur when MP reports are measured two measurement intervals (approximately 5 months) before the perceptual variables, indicating that an excessive number of MP reports may serve as a very early warning of deteriorating unit conditions. AWOLs, on the other hand, show a somewhat different pattern of correlations across time. For

AWOLs, the highest correlations with the macro scales occur after one measurement interval (10 weeks). Also, AWOLs and Moral Climate and AWOLs and Unit Effectiveness show the highest correlation when the macro scale leads AWOLs in time, which seems to suggest that negative perceptions of the unit will be followed by an increase in the number of AWOLs. On the other hand, AWOLs and EM Cohesion are more highly correlated when AWOLs lead in time, indicating that AWOLs will be followed by reduced perceptions of closeness among the enlisted soldiers.

Leader Punishments. Two variables, residualized Article 15s and residualized Unprogrammed Discharges (UPD) were included in the leader punishment category. The UPDs included only "punitive" discharges such as Chapter 5 or Chapter 13. Medical and hardship discharges were not included. Article 15s produced four significant relationships with the macro scales. The pattern of correlations in each case is fairly consistent. The correlations are generally negative with the highest correlations occurring when Article 15s are measured before the macro scales. The correlations are less consistent with UPDs. Leadership Climate and EM Commitment show generally negative correlations with UPDs, but without a consistent pattern of cross-time correlations. Leader Strictness, on the other hand, shows a positive correlation with UPDs and roughly equal cross-time correlations regardless of which variable is leading. Overall, these results suggest that Article 15s and UPDs have a negative impact on perceptions of the unit, although the pattern of correlations with UPDs is somewhat inconsistent.

Leader Rewards. Cross-lagged comparisons using the two leader reward variables, Awards and Promotions, produced two significant comparisons, Promotions with Racial Climate and Awards with Unit Effectiveness. In the comparison between Promotions and Racial Climate the two 5-month correla-

tions are the strongest, with a negative sign when Promotions lead in time and a positive sign when Racial Climate leads in time. This sign reversal may indicate a negative feedback relationship where positive racial climate increases the number of promotions, while large numbers of promotions decrease racial harmony. This latter finding may indicate that minorities view promotions as unfair and react negatively to them. Awards showed weak positive correlations with Unit Effectiveness with no particular time precedence.

Enlisted Turbulence. There were four significant relationships found when measures of enlisted turbulence were compared with the macro scales. Number of Arrivals (residualized) showed a weak positive relationship with Moral Climate, while Average Time in Unit showed generally negative correlations with EM Commitment, Moral Climate, and Unit Effectiveness. Since numerous arrivals indicate high turbulence and long time in unit indicates low turbulence, the overall pattern of results indicates that enlisted turbulence (ie., high rates of enlisted turnover) are associated with more positive perceptions of the unit. While it may be possible that low enlisted turnover actually produces behavioral changes which degrade perceptions of unit effectiveness (for example soldiers entering a new unit may initially be on their "best behavior"), an alternative explanation for this finding is that the longer soldiers are in a unit the more aware they become of existing unit problems, resulting simply in a change of perception rather than a change of actual behavior. To try and confirm an actual behavioral change as a result of enlisted turbulence, correlations were computed between enlisted Time in Unit and Article 15s, AWOLs, and MP reports. None of these correlations were significant so the hypothesis of an actual behavioral change could not be confirmed. However, this should not be con-

sidered as evidence against the hypothesis since the power of this analysis is unknown, but probably fairly low.

Officer & NCO turbulence. Average Time in Unit scores, calculated separately for grades E5-E9 and 01-03, were used as measures of NCO and officer turbulence. While there were no significant effects of NCO turbulence, officer Time in Unit produced generally positive correlations with Leadership Climate, Racial Climate, Moral Climate, and Unit Effectiveness. The correlations indicate that infrequent rotation of officers in and out of units is advantageous for unit effectiveness.

Officer experience and education (01-03). All four of the record data measures used in this category, Years Civilian Education, Highest Military Education Level, Average Time in Service, and Average Time in Grade produced at least one significant comparison with the macro scales and the strongest of these variables, Average Time in Service, correlated with all the macro scales except Strictness. Overall, this category of variables has the highest percentage of significant relationships of any of the categories examined and some of the individual correlational coefficients are fairly large (eg., .43 when Average Time in Service leads Leadership Climate), indicating that officer experience is a very potent variable. As might be expected, the correlations in this group are almost universally positive indicating that officer experience is associated with high unit effectiveness. There are at least two possible explanations for this finding: one, of course, being that officers become better leaders as they gain more experience; at the same time, it may also be true that poor leaders are relieved of their commands before they have very much tenure. In actuality, both factors are probably operating. In any case, the implications of this finding seem to be that an experienced leader is an extreme-

ly valuable resource, and that steps should be taken to insure that experienced leaders are retained in the service where their skills can be utilized.

NCO experience & education (E5-E9). The NCO experience and education measures produced a different pattern of results than the corresponding officer measures. Only three significant relationships with NCO experience were found. Average Time in Service and Average Time in Grade were correlated with Racial Climate and, additionally, Average Time in Grade was correlated with EM Cohesion. The pattern of these correlations is such that the correlations are positive when the NCO experience variable leads in time, and negative when the perceptual variable leads in time. This pattern is indicative of a negative feedback relationship in which NCO experience improves perceptions of racial climate and cohesion, which in turn tend to lower NCO experience. The experience of a unit's NCOs would be reduced as the experienced NCOs either transfer (PCS) or leave the service (ETS). It may be possible that perceptions of racial harmony and cohesion cause NCOs to PCS and/or ETS, although the reasons this might occur are not apparent.

Enlisted education & experience (E1-E4). Three variables were constructed to measure enlisted experience and education (in grades E1-E4). They were: Years Civilian Education; average General Technical Aptitude Score (GTAS); and Average Time in Service. GTAS score was significantly correlated with Leadership Climate, EM Commitment, and EM Cohesion. Correlations in this group with GTAS leading in time were generally negative. Correlations with a macro scale leading in time were also negative (but quite low) for Leadership Climate and EM Commitment, but positive and somewhat higher when EM Cohesion was leading. Apparently units with high GTAS scores tend to have negative perceptions of the unit, while perceptions

of cohesion tend to be associated with increased GTAS scores.

The other significant comparison in this group, between Average Time in Grade and Leader Strictness, showed relatively weak positive correlations which were approximately equal with either variable measured first in time.

Racial variables. Three racial variables were computed and compared with the macro scales. They were: the Percent Minority Personnel in the Unit; a "discrimination indicator" for promotions; and a "discrimination indicator" for Article 15s. The "discrimination indicator" (DI) is an index which compares the actual number of blacks or minority individuals in a category or group with the number of individuals which could be expected in the group, if race was unrelated to group membership. If the actual number of individuals is approximately equal to the expected number, the DI will be near zero. If there are more minority individuals in the group than expected, the DI becomes positive, if there are less minority individuals than expected, the DI becomes negative (Dept. of the Army, Note 9; Nordlie, Thomas, & Sevilla, Note 15).

Both Article 15 and Promotion DIs produced significant correlations with the macro scales. Correlations with the Promotion DIs were positive while correlations with the Article 15 DIs were negative. Units where blacks receive less than their share of promotions would have positive DIs. Units where blacks receive more than there share of Article 15s would have negative DIs. Therefore, both the positive correlation with the Promotion DI and the negative correlation with the Article 15 DI indicate that institutional discrimination has a negative impact on perceptions of unit effec-

tiveness.

The percent minority individuals in a unit produced a single significant relationship with EM Cohesion. Most of the correlations in the cross-lagged comparison were negative, indicating that a high percentage of minority individuals in a unit is associated with reduced feelings of closeness among the enlisted soldiers.

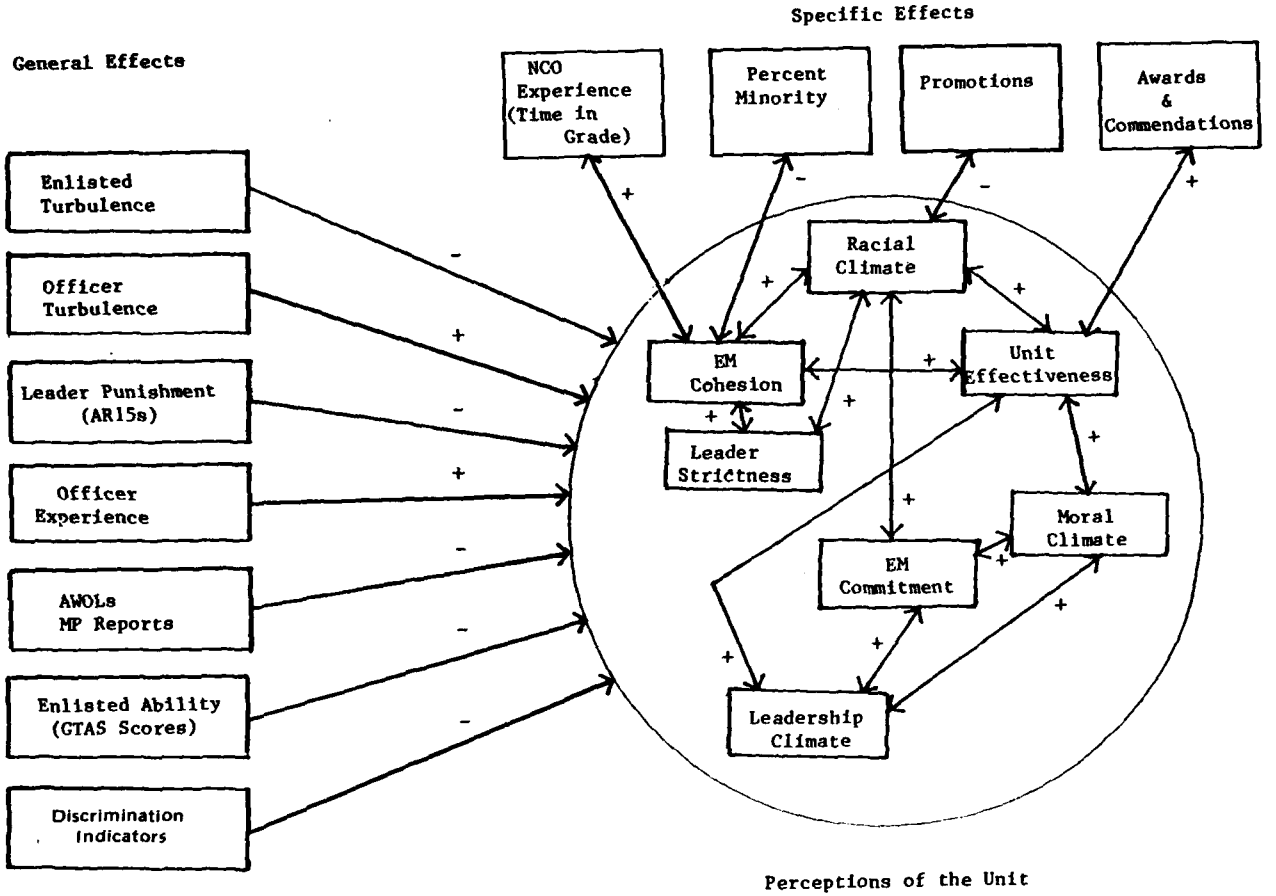
Summary of Record Data-Macro Scale Comparisons

The major trends in the data observed when the macro scales were compared with the record data measures included a strong positive effect of officer experience and a somewhat weaker positive effect of enlisted turbulence. The major negative impacts on perceptions of the unit were officer turbulence, Article 15s, AWOLs, MP Reports, and Discrimination Indicators. The effects of two variables, NCO Experience and Unprogrammed Discharges, were ambiguous and difficult to interpret. Finally, it is interesting to note that a number of variables, which are often officially monitored by the Army, showed little or no correlation with perceptions of unit conditions. These variables include Awards, Re-enlistments, and Unit Status Reports.

System Model

Figure 4 shows the integration of the major relationships between the record data measures and macro scales into the system model. Since the macro scales are highly intercorrelated, and since particular record data variables generally correlated in the same direction with several of the macro scales, the scales are shown in the figure grouped as a single entry labeled "Perceptions of the Unit." The primary record data impacts on perceptions of the unit are shown in the boxes to the left. Record data variables in these boxes are labeled "General Effects" because they corre-

Figure 4. System model of major factors' impacts on unit effectiveness.



lated with more than one macro scale. Since these variables are general effects, their path arrows are shown as impacting on perceptions of the unit as a whole. The sign on the path arrows indicates the direction of the relationship as determined by the predominant sign of the individual correlation coefficients.

Besides the general effects, there were several record data variables which correlated with a single macro scale. These variables are shown at the top of the model and are labeled "Specific Effects." Path arrows for these variables point directly to the macro scale with which they were correlated.

Discussion

The system model shown in Figure 4 is somewhat unsatisfying for a number of reasons. Most obvious of these is its lack of detail, both in terms of specific relationships between variables and the lack of some sort of path coefficients to estimate the magnitude of the effects. However, as discussed previously, there is currently no satisfactory method for estimating meaningful path coefficients for a detailed cross-time model from the data available in this study. Also, while the model in Figure 4 is quite general, it does contain 13 major constructs, many of which are themselves composite variables. To go beyond the 13 basic constructs in Figure 4 in an attempt to substantially interpret all the relationships between the individual variables would be asking a lot of the data, given the relatively small sample size and the instability of cross-lagged correlations demonstrated in Appendix B.

However, despite its limitations, the system model in Figure 4 does suggest some interesting relationships which seem to have important implications for the Army and, which could be examined in more detail in subsequent studies.

Factor Structure of the Macro Scales

One area of interest in the model in Figure 4 is the nature of the macro scales; both in terms of their factor structure and assumptions about what they actually measure. There is a fair amount of disagreement about what an individual's perceptions of his environment actually measure. On one end of a continuum, Bowers and Seashorne (1966), working in the area of leadership climate, argue that perceptions are primarily descriptive and are no different from any other method of quantifying behavior, since "all involve the measurement of behavior by some person or machanism" (p.261). On the opposite pole,

Guion (1973) argues that perceptions cannot be considered a description of objective reality, and that perceptions of organizational climate (of which Bowers and Seashorne's leadership measures could be considered a part) are, in fact, largely mediated by an individual's satisfaction with his environment. Thus, rather than being descriptive, Guion considers perceptions basically an affective, nondescriptive variable. Taking the middle ground, Jones and James (Note 10) maintain a distinction between perceptual/cognitive representations of a situation and affective, evaluative reactions to that situation. Although they acknowledge that the two concepts are often closely related, they maintain that perceptions of behavior (and other environmental) stimuli are primarily descriptive.

Examining the evidence from the present study, the contrast between the conceptual dissimilarity of the various macro scales and the high degree of intercorrelation between them suggests that there is a pervasive underlying variable which unites these apparently different perceptual measures. Guion's concept of satisfaction would seem to be a likely candidate for this underlying variable. Unfortunately, the data collected for the present study does not provide a direct measure of satisfaction with which to test this hypothesis. Some additional circumstantial evidence for the proposition that the perceptual measures used in this study are somewhat less than objective descriptions of reality come from the generally low correlations between the objective record data variables and the perceptual macro scales which were found in this and other similar studies (Jones and James, Note 10; Boyd & Griesemer, Note 6).

Despite these considerations, the fact that correlations exist at all between perceptual and objective measures suggests that perceptual measures do have some utility as descriptive measures. However, whatever descriptive properties the measures may possess are undoubtedly mediated through a complex set

of intervening variables which may include such things as the observer's frame of reference, his pre-existing cognitive structures, his satisfaction with his general situation, etc.

Even if perceptual measures are not primarily descriptive they still may be useful. An assumption which is commonly made, and which appears quite reasonable, is that individuals will act on their perceptions, which makes perceptual measures useful for predicting future behavior. Also, as Jones and James point out, perceptual measures of organizational climate tend to reflect the organizational influences which are psychologically important to the individuals in the situation. In the present study this means that the various factors recovered in the factor analysis represent concepts which are salient for the enlisted soldiers who comprise the majority of respondents. As such, they represent areas which will probably have to be addressed in any attempt to change or monitor the organizational effectiveness of an infantry unit.

The concept of organizational climate factors as psychologically important variables is also relevant to the appearance of the racial and moral climate factors in the present model. Variables such as these usually do not appear in organizational climate models, possibly because they have little relevance to the business and industrial settings in which these models are usually applied. Originally the items comprising these two unusual factors were included in the present study because enlisted soldiers had expressed concerns about these areas to the researchers during pilot interviews. The fact that these areas appeared as factors and correlated highly with more traditional measures of organizational climate indicates that they should be included in future research on organizational climate in Army infantry units, and that these areas will have to be of concern to anyone who is attempting to improve the performance of infantry soldiers.

Personnel Turbulence

The issue of personnel turbulence in the Army has two related aspects, one is the actual transfer of personnel from unit to unit and place to place, while the other is the retention of experienced personnel in the service. The results of the present study have implications for both aspects.

In regard to personnel transfers, the finding of a different valence for the effect of officer and enlisted turbulence is interesting. Turnover among the officers had a negative effect on perceptions of the unit while turnover in grades E1-E4 had a positive effect. This finding has implications for the Army's plan to experiment with a regimental system of assignment in which a soldier would remain with a unit from the time he graduated from basic training until he left the service. In the present study, the average time in unit for officers was a relatively short 265 days, with a maximum of 552 days. These figures indicate that the Army's recent policy decision to increase the tour of company commanders from 12 to 18 months (which was initiated after the data for the present study was collected) can be expected to increase perceptions of unit effectiveness. For enlisted soldiers the average time in unit was 367 days or roughly one year, while the maximum was 513 days or 1.4 years. The finding that an average E1-E4 time in unit as short as 1.4 years can produce measurable decrements in perceptions of effectiveness indicates the army may experience problems with the enlisted soldiers as it implements the regimental system.

The regimental system reportedly has worked well for the British Army but their success with the system may be due to factors other than just

the length of time soldiers remain in the unit. For example, to help maintain cohesion and unit identity soldiers in British regiments often wear distinctive insignia on their uniforms, use their own unique rank titles, and carefully maintain unit traditions and customs. Another important factor may be the availability of recreational opportunities. Recreation may take on additional importance in the regimental system because of the lack of novelty resulting from longer tours of duty. Since the present study suggests that simply lengthening the time a soldier spends in a unit will decrease, rather then increase, effectiveness the Army may have to place strong emphasis on factors such as those discussed above in order to make the regimental system a success.

The other important aspect of the turbulence issue is the retention of experienced personnel. It is generally agreed that increasing the retention of qualified personnel is a major priority in the Army. The strong correlations between the officer experience variables and the perceptions of unit effectiveness attest to the appropriateness of this priority.

Also relevant in this regard is the finding of a negative correlation between General Technical Aptitude Scores (GTAS) and perceptions of unit effectiveness. Initially this finding seems to indicate that units with predominantly high GTAS personnel are less effective. However, an alternative interpretation, which may be more reasonable in this case, is that high GTAS soldiers are less satisfied with conditions in their unit, and therefore, have more negative perceptions of them. If this were true it might be expected that high GTAS soldiers would leave the service sooner than low GTAS soldiers. In fact, the results of a preliminary ARI study which examined retention rates found that soldiers with high mental abil-

ity test scores on Army entrance exams (which are highly correlated with GTAS scores) leave the Army at a much higher rate than soldiers with low mental ability (Goehring, Note 11).

If the negative correlation between GTAS and perceptions of the unit does indeed represent dissatisfaction among the most technically competent individuals it could be a serious problem for the Army. It is exactly these individuals who will be in the greatest demand as Army weapons systems continue to become more technologically sophisticated.

Article 15s and Promotions

These two variables are grouped together because they both represent ways in which a company commander intervenes administratively to control his unit, and because both variables were correlated negatively across time with perceptions of unit effectiveness. Article 15s correlated negatively with four of the macro scales, while promotions correlated negatively with racial climate.

It's not too surprising that Article 15s correlate negatively with unit perceptions but the finding that promotions can have a negative impact on promotions occurs with racial climate, it may be that minorities view promotions as unfair and react negatively to them. Examination of the means for a number of individual survey items indicates that a large percentage of individuals do believe that promotions are unfair. The enlisted respondents estimated that only 44% of their peers agree with unit leaders about who should be promoted, while 42% said that company leaders tend to promote the least intelligent individuals.

To attempt to determine if there was any objective basis to these negative perceptions of the promotions system, an overall DI for promotions

was calculated by aggregating data across all 60 units in the sample. The overall DIs were fairly close to zero (5.69 for blacks, and -5.68 for whites), indicating that, overall blacks and whites receive promotions roughly in proportion to their racial distribution. By this criterion at lease, the promotion system can be considered fair, and thus cannot account for the negative overall correlations between promotions and racial climate. (Although when institutional discrimination in promotions actually does exist it will impact negatively on the racial climate as was shown by the correlations between company level DIs and racial harmony, which was first presented in Table 9). One possible explanation for the negative overall correlations between promotions and racial climate in the absence of any overall pattern of discrimination in this sample is what might be called a negative halo effect. Blacks may have the expectation that promotions are discriminatory even when they are not. The negative set may well come from historical patterns of discrimination against blacks in the Army (Department of the Army, Note 9). For example, while the overall DI for promotions was 5.69, a third of the individual units in the sample had DIs less than -30, which indicates a fairly large under-representation of black promotions in these units.

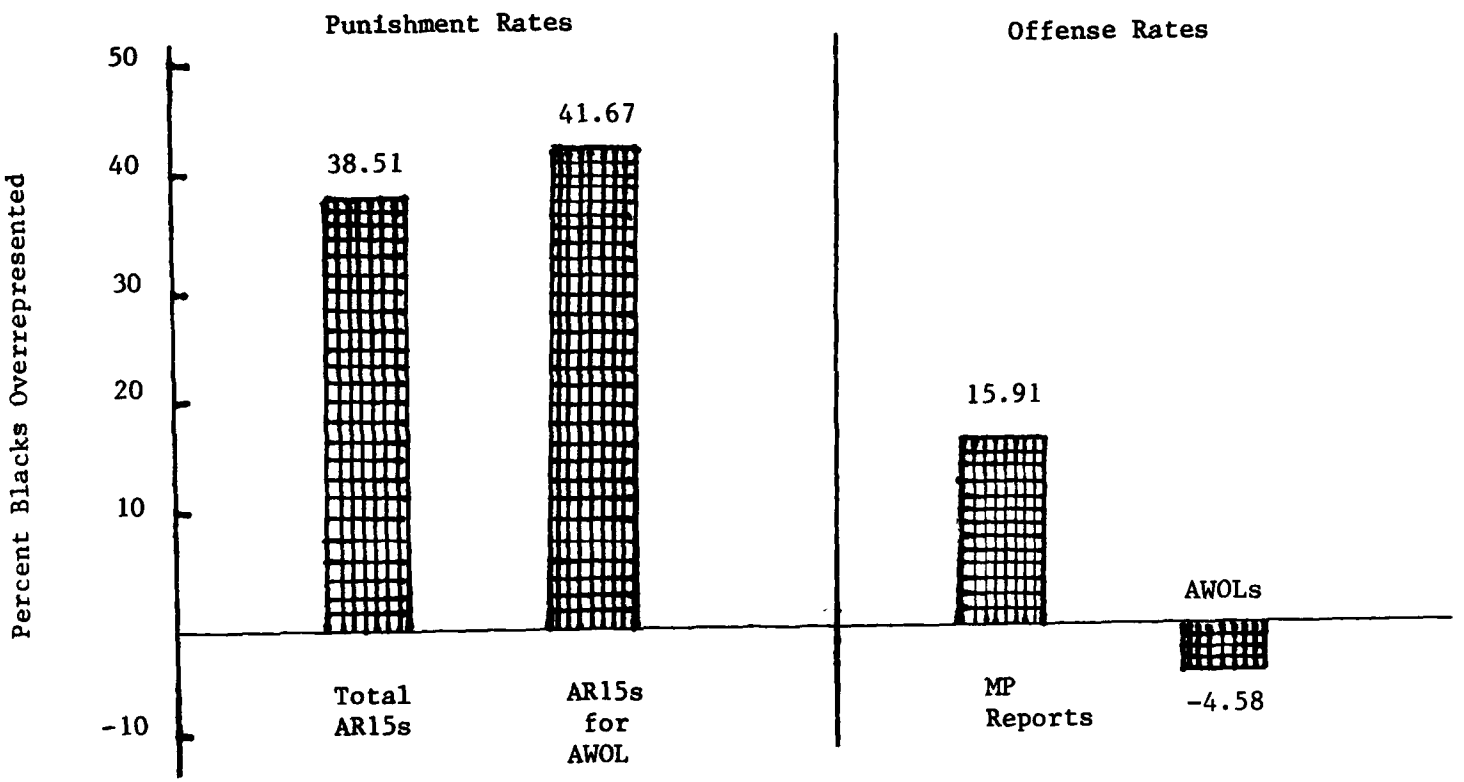
Like promotions, punishment in the units surveyed was considered unfair by a large number of respondents. Soldiers in grades E1-E4 estimated that only 38% of their peers agreed with unit leaders about who deserves to be punished, and 54% stated that company leaders very frequently punished innocent enlisted soldiers. With such a high percentage of the

enlisted soldiers believing that punishment is unfair, it is not surprising that high numbers of Article 15 punishments are associated with more negative perceptions of the unit by the enlisted soldiers.

One reason that enlisted soldiers view punishment as unfair is that there is a large discrepency between the perceived offense rate and the perceived punishment rate. When asked what percent of the enlisted soldiers in the unit broke rules or laws for which they could reasonably be punished, the E1- E4s estimated that an average of 51% broke rules or laws. However, when asked about the punishment rate, only 17% of the E1-E4s reported that they had actually been punished by the unit leaders. Unit leaders (CO & 1SG) on the other hand, estimated that 24% of the enlisted soldiers in their units broke rules for which they could reasonably be punished. The closeness of the leaders' estimate of lawbreaking and the enlisted reports of punishment indicate that unit leaders are punishing subordinates roughly in line with their own perceptions of the amount of lawbreaking. However, unit leaders cannot be everywhere and see everything, and of course subordinates are likely to hide actions which will result in punishment. Therefore, unit leaders are probably unaware of much of the rule and law breaking that goes on in their units. The resulting low level of punishment may interact with the high perceived offense rate among the enlisted soldiers to produce feelings of injustice in those few offenders who were "unlucky" enough to be caught and punished.

A second factor which may produce feelings of unfairness about punishment and discipline is perceived racial or other bias in the application of punishment. There is evidence that, in many cases, racial factors are related to punishment and discipline. For example, Figure 5 presents the overall

Figure 5. Discrimination Indicators comparing black offense rates to black punishment rates.



discrimination indicators for two measures of punishment rates: total Article 15s, and Article 15s for AWOL; and two measures of offense rates: MP reports, and AWOLs as reported by SIDPERS DYST (duty status) transactions. The left side of Figure 5 shows that blacks are highly overrepresented in terms of the number of Article 15s they receive. Of course, it might be argued that blacks commit more offenses than other racial groups and, therefore, receive more punishments. However, examination of the two offense rate measures presented in Figure 5 provide little evidence for this proposition. The figure shows that blacks are slightly overrepresented in the number of times they are the subject of MP reports, but that this overrepresentation is less than the overrepresentation found in total Article 15 punishments. The second offense rate DI, AWOLs, shows that blacks are actually underrepresented on this dimension (i.e., they go AWOL at a rate lower than whites), yet they still received far more than their expected number of Article 15s for AWOLs. Given this apparent imbalance between offense rates and punishments, it is not surprising that enlisted soldiers view punishment and discipline as unfair, and that the issuance of a large number of Article 15s is associated with more negative perceptions of the unit.

Strength and Generality of the Relationships

A number of findings in this study could have important implications for the Army. For example, the findings on turbulence, GTAS scores, and officer experience may be of interest to policy analysts. The findings on Article 15s, AWOLS, MP reports and racial discrimination could be useful to unit commanders in performing their leadership and personnel management tasks. However, the correlations on which these findings are

based, while statistically significant, are not especially strong. Typically they are in the .25 to .35 range and account for only 5 to 12% of the variance.

Whether relationships of this size are important or not is determined primarily by the importance attached to the particular variables involved and is, therefore, a policy issue as much as a research issue. The problem is complicated by the fact that correlation coefficients will always under-estimate the true variance accounted for in a relationship because measures are never perfectly reliable, and by the fact that a policy change based on such a finding will never perfectly manipulate a variable when it is applied in the field. These factors combine to make the size of the correlation between two variables a relatively poor measure of the true strength of a relationship. Probably the best way to determine the importance of any particular finding is by implementing a carefully controlled evaluation study in the field. However the relatively high cost of such studies make them feasible only for areas of high priority and/or large potential benefits.

An additional factor which must be considered along with these findings is the fact many of the results are based on the relatively new technique of examining cross-time correlations. As Appendix B illustrates cross-time correlation can behave in unusual and counter intuitive ways. An extremely valuable step in accessing the validity of cross-time correlation analysis would be to attempt replicate findings such as the ones in the report in the context of an experimental design. Such a study has, to the best of this author's knowledge, never been attempted.

The generality of the findings in this report is another issue which

must be considered. This research was done on a relatively small sample of combat line companies but at least some of these results have been replicated in other studies using combat units (eg. the Article 15 and MP report findings which are similar to those of Hart(1978)). This fact, and the fact that the data from the present study was collected from two separate and geographically distant divisions, suggests that generalization to other combat line units is appropriate. It is unknown whether the results would generalize to combat support units or other types of units with more technical or administrative missions.

HYPOTHESES RELEVANT TO THE DEVELOPMENT OF A UNIT PERSONNEL MANAGEMENT MONITORING SYSTEM

One possible application of the information from the preceding system modeling effort is the development of a unit personnel management monitoring system. This system would provide commanders with a tool for diagnosing conditions in their units which have been shown to cause reduced unit effectiveness.

The need for such a system is illustrated by the correlations presented in Table 10. Table 10 shows intra-group correlations for 13 survey scales which were used as components of the macro scales. The left most column presents significant correlations between black and white enlisted respondents (E1-E4), followed by correlations between all E1-E4s and the CO in the second column, all E1-E4s and the 1SG in the third column, and between the CO and 1SG in the fourth column. The correlations indicate that while there is at least a moderate consensus between black and white enlisted respondents, there is very little agreement between the enlisted soldiers and the CO and 1SG, or even between the CO and 1SG regarding attitudes toward and perceptions of unit conditions. This lack of consensus between unit leaders and subordinates can cause difficulties. Individuals tend to act on the basis of their perceptions, and thus, to fully understand their troops, leaders must understand and be aware of the way they perceive their environment.

The relationships presented in the system model provide a number of hypotheses relevant to a unit personnel management monitoring system. On a general level, the study indicated that negative perceptions of the concept areas represented by the macro scales, such as EM Commitment, Cohesion, Moral Climate, Leadership Climate, and Racial Climate were correlated with both face

Table 10

Significant[a] Scale Correlations Between Respondent Groups

Scale	Respondent Group: Black & White E1-E4	Total E1-E4 & CO	Total E1-E4 & 1SG	CO & 1SG
Discipline	.34	.15		
Cohesion	.25		.15	
Percent Trusted in Battle				
Insubordination	.27	.20		.40
Leader Performance Rating	.45			.15
Lawbreaking				
Overt Racial Hostility	.21		.18	
Racial Solidarity	.26	.18		
Attitude Toward Integration				
Overall Racial Climate	.30			.16
Leader Fairness & Consideration	.47			
Leader Sacrifice	.23			
Leader Strictness	.23			
Total Number of Significant Correlations	10	3	2	3

a. $p < .05$, number of subjects ranges from 168 to 179 depending on the particular comparison.

valid perceptions of unit effectiveness and with objective record data indicators of effectiveness. Therefore, one approach to a unit personnel management monitoring system would be to design a short survey around the major perceptual factors which were isolated in the study. An attempt to select items for such a survey is shown in Table 11. To construct Table 11, item-total correlations were calculated between the company level macro scale scores used in the system modeling and the company level means for each individual item included in the scales. To reduce the number of items required for the monitoring survey, a subset of items was chosen for each of the seven macro scales which would maximize both the internal consistency of the indices and their independence. To accomplish this, the items for each index with the highest item-total correlation were selected (up to a maximum of 10 items per index) but only if the correlation between the item and its own index was at least .20 greater than between the item and all the other indices. (No items met the criterion for inclusion into the EM Commitment index so it was not included in the table.)

Examination of the items in Table 11 reveals that there would be substantial practical problems incorporating them into a survey to be used by the company commander. For example, many leaders are offended by the idea of being rated by their subordinates, which is essentially what the enlisted soldiers would be doing in filling out the Leadership Climate and Strictness items. The enlisted soldiers in turn, are likely to react negatively to the Moral Climate items, which to a large extent would be self incriminating. Elimination of these areas would leave Unit Effectiveness, Cohesion, and Racial Climate, however, other survey instruments which deal with these areas have already been developed (for example, the TDAS, Brown, Note 12; and the GOQ, Organizational

Table 11

Correlations of Questionnaire Items with Macro Scales

for Items Which Met Criteria for Inclusion on Monitoring Survey

Item Total Correlation	Item Description
	Leadership Climate
.80	Are CO & 1SG willing to risk poor OER/EER to protect EMs from unfair demands
.82	EMs agree about who deserves punishment
.79	CO emphasizes policy of treating all fairly and equally
.77	EMs treated in a positive way no matter what they have done
.78	EMs feel like protesting the actions of their leaders
.75	Company leaders treat group members as equals
.82	Leaders treat all fairly and justly
.74	EMs rate CO
.72	Leaders put suggestions made by group into operation
.70	Leaders punish innocent enlisted soldiers
	Unit Effectiveness
.76	% group members trusted in battle
.76	Willingness to fight
.72	Are equipment & resources adequate, efficient, and well maintained.
.72	Members of unit do high quality work
.74	Company generally quick to use improved work methods

Table 11 - Continued

Correlations of Questionnaire Items with Macro Scales

for Items Which Met Criteria for Inclusion on Monitoring Survey

Item Total Correlation	Item Description
	Cohesion
.93	EMs close during past 8 weeks
.91	EMs distant during past 8 weeks
	Strictness
.86	Company leaders require respect for authority at all times
.89	Company leaders establish strict rules against disobedience
	Moral Climate
.58	Illegal activities
.65	Making company weak and ineffective
.57	White EMs who talked about forming all-white groups
.68	Breaking rules on purpose to get out of Army
.64	Selling pot
.43	Smoking pot
.68	Breaking as many rules and regulations as possible without getting caught
.63	Seriously violating the law
.59	Showing respect for the law
	Racial Climate
.83	Race relations good/bad past 8 weeks
.82	Race relations getting better/worse past 8 weeks
.79	Blacks & whites better off living and working separately

Table 11 - Continued

Correlations of Questionnaire Items with Macro Scales

for Items Which Met Criteria for Inclusions on Monitoring Survey

Item Total Correlation	Item Description
	Racial Climate
.78	Close friendships occur between blacks & whites
.76	Black & white soldiers have a lot in common
.74	Good solutions are found for racial problems
.74	Blacks & whites should work in separate groups
.73	Whites make blacks feel unwelcome in areas open to all
.73	Blacks & whites hang around together after duty hours
.71	How often does racial conflict interfere with work

Effectiveness Center & School, Note 13) which could be used by unit commanders if they felt the need.

An alternative approach is to use a number of record data indices to monitor the unit. While this technique does not have the obvious face validity of the perceptual measures, problems involved with survey administration would be avoided. Figure 6 presents one possible approach to a monitoring system which uses only record data. This technique takes advantage of the fact that Article 15s, AWOLs, MP reports, and the Promotion and Article 15 Discrimination Indicators are each correlated with several of the macro scales. Therefore, by monitoring these few variables, a commander could get a broad and relatively objective secondary index of what the perceived effectiveness of the unit is likely to be. A further advantage of using these particular variables is that information about them is commonly available at the unit or battalion level which makes it easy for company commanders to obtain the necessary data.

The system consists of a worksheet which the unit commander can use to monitor these record data variables. The information required and the techniques used were made as simple as possible so that users could complete the exercise with a minimum of effort. As Figure 6 shows, items 1 and 2 of the worksheet ask the commander to estimate the number of Article 15s, AWOLs, and MP reports which can be expected in his unit, using linear regression equations estimated from the data collected for the present study. The questions on this part of the worksheet ask the commander to aggregate the data over a period of seven months. The use of some fairly long aggregation interval is necessary to smooth out random deviations and provide adequate frequency of occurence for these variables. Seven months was used in this case simply because the

Figure 6. Prototype unit personnel management monitoring system work sheet.

1) Excessive Article 15s can be an indicator of future trouble in your unit. Too many Article 15s may actually increase lawbreaking. To see if your unit has more Article 15s than the typical unit, fill in the formula below and compare the result with the number of Article 15s in your unit over the last 7 months.

a)

# of E1-E4s in your unit					Expected ART15s		Your actual ART15s over past 7 mos		Article 15 Difference
_____	X	.04	+	16.6 =	_____	-	_____	=	_____

2) Excessive MP Reports and AWOLs have also been found to be negative indicators of unit effectiveness. Complete the formula below to see how your unit compares with the typical unit on MP Reports and AWOLs.

a)

# of E1-E4s in your unit				Expected MP Reports		Your actual MP Reports past 7 mos		MP Report Difference
_____	X	.29	=	_____	-	_____	=	_____

b)

# of E1-E4s in your unit					Expected AWOLs		Your actual* AWOLs over past 7 mos		AWOL Difference
_____	X	.04	+	1.25 =	_____	-	_____	=	_____

3) Racial discrimination in punishment and promotion, or the perception of discrimination, have negative effects on your unit. Sometimes disproportionate numbers of Article 15s or promotions are given to a particular racial group. To determine if Article 15s or promotions have been given out dispropotionately, complete the formula below.

Promotions

a)

Total promotions past 7 months		Black E1-E4	Total E1-E4		Expected Black Promotions		Actual # of Blacks Promoted		Difference
_____	X	(____	/ ____)	=	_____	-	_____	=	_____

* Count only AWOLS longer than 24 hours.

Figure 6 - continued

3) Promotions - continued

b)

Total promotions past 7 mos		White E1-E4	Total E1-E4	Expected White Promotions	Actual # White Promotions	Difference
_____	X	(____ / _____)	=	_____	- _____	= _____

c)

Total promotions past 7 mos		Other* E1-E4	Total E1-E4	Expected Other* Promotions	Actual # Other* Promotions	Difference
_____	X	(_____ / _____)	=	_____	- _____	= _____

Punishment

d)

Total ART15s past 7 mos		Black E1-E4	Total E1-E4	Expected Black ART15s	Actual # Black ART15s past 7 mos	Difference Black ART15s
_____	X	(____ / _____)	=	_____	- _____	= _____

e)

Total ART15s past 7 mos		White E1-E4	Total E1-E4	Expected White ART15s	Actual # White ART15s past 7 mos	Difference White ART15s
_____	X	(____ / _____)	=	_____	- _____	= _____

f)

Total ART15s past 7 mos		Other* E1-E4	Total E1-E4	Expected Other* ART15s	Actual # Other* ART15s past 7 mos	Difference Other*ART15s
_____	X	(____ / _____)	=	_____	- _____	= _____

---

* Other = non-black and non-white E1-E4s.

Figure 6 - continued

4) Offense Rates (Optional)

If one of the racial groups in the section above is highly overrepresented in terms of punishment it may be justified by a high offense rate in that group. To see if a particular racial group commits more than its share of punishable offences complete the formula below.

a)

Total MP reports & AWOLs over past 7 mos	Racial Group's E1-E4	Total E1-E4	Expected Offense Rate for Racial Group	Actual # MP reports & AWOLs for Racial Group past 7 mos	Offense Rate Difference
_____	(____	/ ____) =	_____	- _____	= _____

If the offense rate difference is less than 20% of the actual MP reports & AWOLs for that racial group (Actual MP reports x .2) then the overrepresentation in Article 15s is probably not justified by the offense rate.

5) Scoring

Examine the various differences which you calculated in the right most column of each page. Fairly large negative differences (ie. greater than 20% of the corresponding actual number of occurrences) indicate areas which should be of concern. Count up the total number of differences greater than 20% and write the number at the bottom of the page. You can use this number for comparison the next time you complete this form. Remember a high score means the indicators are more negative, a low score means the indicators are more positive.

Number of
Differences
Greater than 20% = _____

data from the present study for regression estimates was available in that form. In practice, a more convenient interval such as six months would probably be more desirable.

In the next section of the worksheet, the commander estimates the number of promotions and the number of Article 15s which would be expected for each racial group, using formulas similar to those used for DIs. For each estimate throughout the worksheet, the commander is asked to make a comparison with the actual number of promotions, Article 15s, etc. by subtracting the actual number from the expected number. When the actual number of an indicator is 20% greater than the expected number, the indicator is considered negative. The 20% figure was simply chosen arbitrarily, and is designed to prevent small inaccuracies in the estimation process from giving negative signals, and also to be easy for the commanders to use.

It should be pointed out that a worksheet such as the one in Figure 6 would not be applicable to all types of units. The regression equations in items one and two in particular would change, since different types of units would be expected to have different underlying rates of Article 15s, AWOLs, etc. As an addition to the worksheet, it might be desirable to include recommendations to the commander on what should be done if the worksheet produces a number of negative indicators. It might be possible to key a particular record data indicator to the questionnaire items in Table 11, to give the commander a series of statements which describe the perceptions his men are likely to have. Another alternative would be to direct leaders to the appropriate sections of existing Army publications such as FM 22-100 (Military Leadership, Department of the Army, Note 14) which discuss most of the issues raised by the questionnaire items and also suggests appropriate strategies for dealing with those issues.

As presently designed, the work sheet could be utilized as a management aid for unit level commanders. It can give a commander a rough idea of how his Article 15, AWOL and MP report rate compares with other units via the normative data implied in the regression equations used in items 1 and 2. It can also indicate the presence of racial bias in promotions and punishment. In addition, a commander could track long term trends in these areas by repeated use of the work sheet over time. The worksheet is not intended for use as a routine reporting document, or for formal evaluation purposes. It seems likely the use of the worksheet for such purposes could produce distortions in the data which would invalidate the relationships on which the worksheet was based.

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APPENDIX

AN EXAMINATION OF CROSS-LAGGED PANEL ANALYSIS

LIST OF FIGURES

Cross-lagged panel analysis was originally proposed by Campbell and Stanley (1963) and later formalized by Kenny (1973, 1975). In a three-time wave design such as the present study, this method of analysis involves calculation of three different groups of product-moment correlation coefficients for each pair of measures (X and Y). They are: 1) Synchronous correlations which are calculated from different variables measured at the same time (i.e., r_{x1y1}, r_{x2y2}, r_{x3y3} where the numeric subscripts represent time); 2) Cross-lagged correlations which relate different variables measured at different times (r_{x1y2}, r_{x2y3}, r_{x1y3} in which X leads in time, and r_{x2y1}, r_{x3y2}, r_{x3y1} in which Y leads in time); and 3) Autocorrelations involving a single variable measured at different times (r_{x1x2}, r_{x2x3}, r_{x1x3} for X and r_{y1y2}, r_{y2y3}, r_{y1y3} for Y).

Synchronous correlations are the type used in traditional single-time wave studies. Although this type of correlation indicates which variables are linearly related, it gives no information concerning the source of the relationship (i.e., the causality). In particular three basic hypotheses are confounded: 1) X is causing Y; 2) Y is causing X; and 3) the null hypothesis that X and Y are related because they are both being caused by a spurious third variable. Information contained in the cross-lagged correlations is used to distinguish between these rival hypotheses by assuming that, in a causal relationship, the cross-lagged correlations with the causal variable leading in time will be larger than the cross-lagged correlation with the caused variable leading in time. Thus, in cross-lagged panel analysis, the magnitude of the difference between the cross-lagged correlations is used to indicate the strength of the causal relationship while the sign of the difference in-

dicates the direction of causality.

Take for example the following cross-lagged correlation: r_{x1y2}=.30; r_{x2y1}=.04. The cross-lagged correlation with X leading is highest, producing a positive cross-lagged difference of .30 - .04 = .26. This result indicates that X causes increases in Y because the cross-lagged correlation with X leading (.30) is higher than the cross-lagged correlation with Y leading (.04). On the other hand, if r_{x1y2}=.04 and r_{x2y1}=.30, the cross-lagged difference would be .04-.30=-.26, indicating that Y causes X because the cross-lagged correlation with Y leading is the highest. If r_{x1y2}=.30 and r_{x2y1}=.30, cross-lagged difference would be .30 - .30 = 0.0, indicating that the correlation between X and Y is the result of a spurious third variable.

Unfortunately, there are several limitations to this method of cross-lagged analysis which make its application in the present study problematic. First of all, the model only handles simple two variable relationships where one variable, X, causes another variable, Y (i.e., X$\longrightarrow$ Y). The model cannot identify a co-causal relationship where each variable causes the other (i.e., X$\longrightarrow$ Y$\rightarrow$X). In a study of complex group interactions such as this one co-causal relationships can be expected more often than not, giving cross-lagged panel analysis limited utility.

Another problem with cross-lagged panel analysis is that it cannot handle more than two time waves. Although Kenny (1974) proposed a model for three wave panel analysis, it was found during the Task A analysis that the technique lacked sufficient power to be useful. Other researchers have also noted this problem (eg., Schlegal & DeTecco, Note 1). Thus, lacking a better method, multiple wave designs must be treated simply as

a series of two-wave replications. The numerous correlations which result from this process make the control of the Type I error rate more difficult and also complicate interpretation of the results.

Finally, and most importantly, a number of researchers (Heise, 1970; Pelz and Lew, 1970; and Rogosa, 1980) have pointed out several situations in which simply examining the differences between two-wave cross correlations as is typically done in cross-lagged panel analysis, may either; 1) indicate no causal relationship when there is one; 2) indicate a causal relationship opposite in direction or sign from the actual causal relationship; or 3) indicate a causal relationship where none exists. Unfortunately , as can be seen from the discussion which follows, these are not rare situations, but rather, are so pervasive that one or another can be expected to occur in nearly every panel study.

Figures 1 through 7 illustrate a number of situations where cross-lagged panel analysis can produce misleading results. A Monte Carlo simulation and plotting technique originally developed by Pelz and Lew was used to create the figures. Figure 1 shows the plotted results from three runs of the simulation. The graphs in the figure show the simulated cross-lagged correlations between two variables plotted as a function of the measurement interval. (The measurement interval is the number of simulated time periods between the measurement of X and the measurement of Y). Cross-correlations in which Y was measured first in time are plotted on the left side of the graph and the measurement interval is shown with a negative sign. Correlations in which X is measured first in time are plotted on the right side of the graph and have a positive measurement interval. Figure 1a shows the pattern of corre-

Figure 1. Simulated cross-correlations for synchronous one-way causal and spurious models.

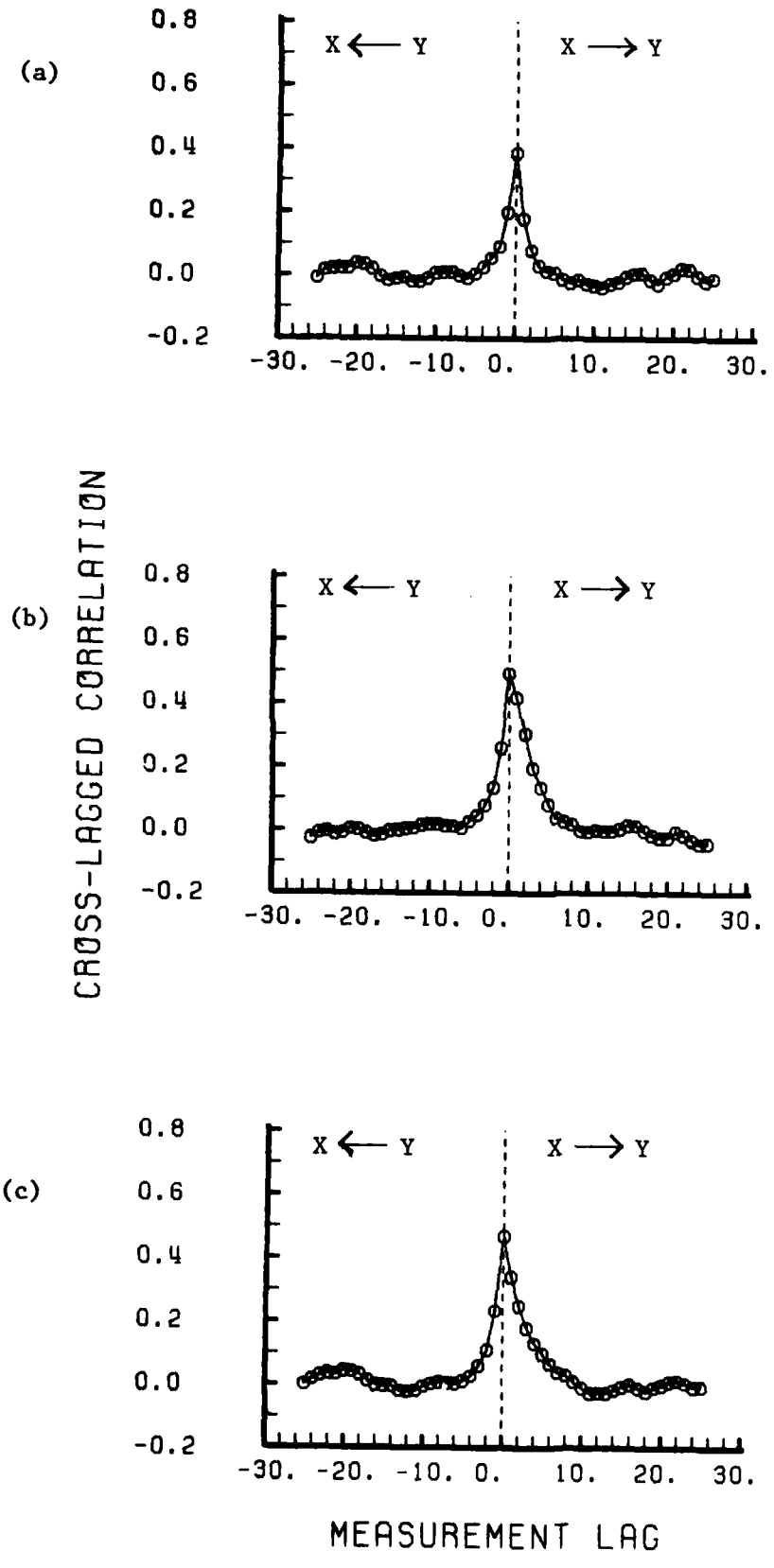
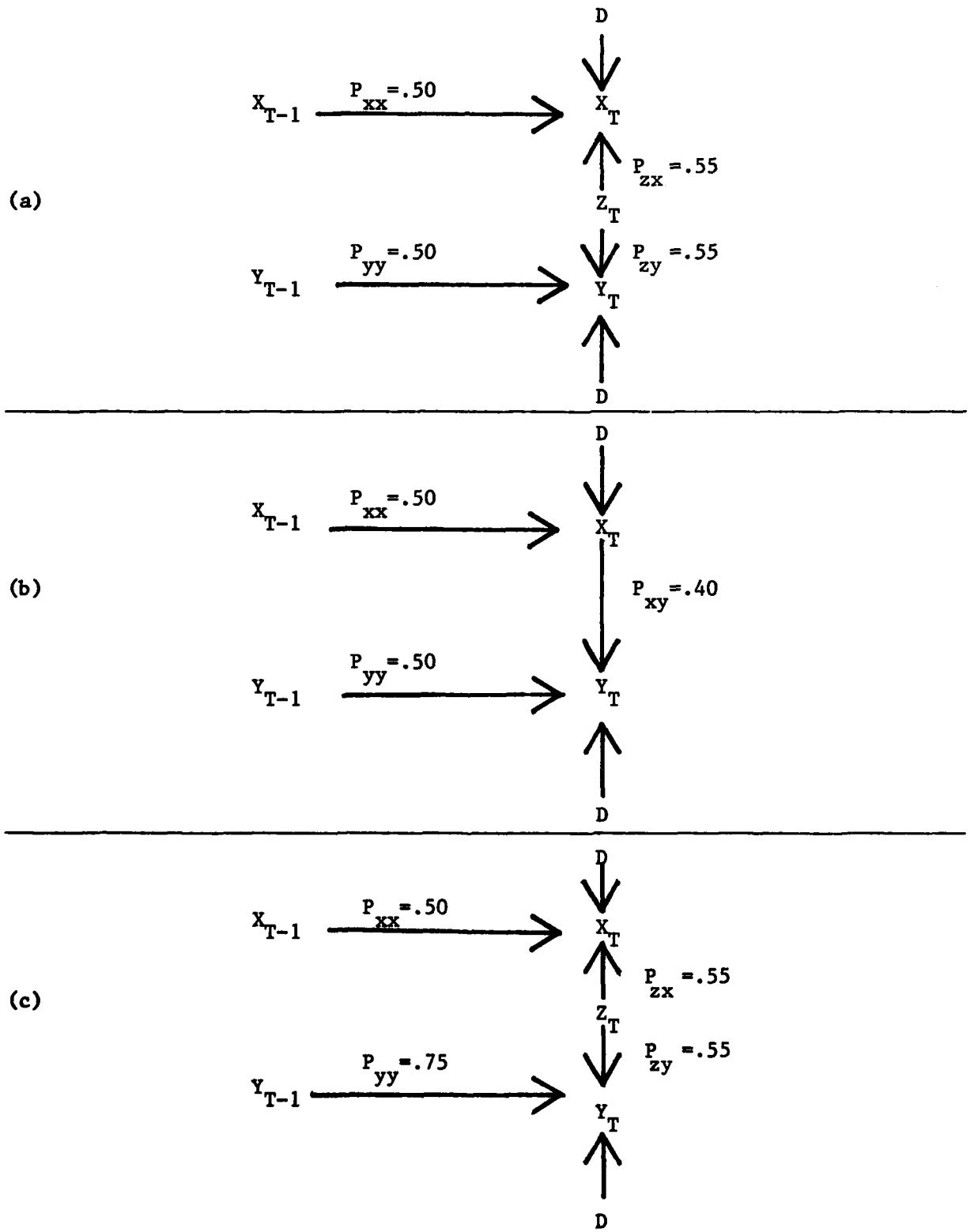


Figure 2. Path models for the equations used to generate the simulated cross correlations in Figure 1.



lations generated by a non-causal model. The data for Figure 1a were generated with a set of structural equations in which X and Y are caused by a spurious third variable, Z, with a path coefficient of .55 ($P_{x2} = P_{y2} = .55$). X and Y also have equal autocorrelations ($P_{xx} = P_{yy} = .50$) and equal random disturbances ($P_{dx} = P_{dy} = .67$). The equations used to generate 1a are shown graphically in the path model in Figure 2a. As can be seen by the symmetry of the curve in Figure 1a, this model produces roughly equal cross-correlations (i.e., a zero cross-lagged difference) at any particular measurement interval, regardless of whether X or Y is measured first in time. In this case at least, cross-lagged panel analysis would correctly indicate the spurious nature of the X-Y relationship.

Correlations from a simulated causal relationship between X and Y are shown in Figure 1b. The equations used to generate Figure 1b were similar to those in Figure 1a except that the spurious variable, Z, was removed and replaced by a causal path leading synchronously from X to Y (this model is shown in the path diagram Figure 2b). In this case, cross-correlations at a given measurement interval, which are significantly different from zero, are greater on the right side of the graph where X is measured first than on the left side of the graph where Y is measured first. Again, in this situation, cross-lagged panel analysis would give the correct indication that X was causing Y, but only if the researcher happened to pick a measurement interval which was shorter than 4 time intervals. If a measurement interval longer than 4 time intervals was used, cross-lagged panel analysis would incorrectly indicate spuriousness. This is because both cross-lagged correlations would be approximately equal to zero, resulting in no cross-lagged dif-

ference.

Figure 1c shows a pattern of cross correlations almost identical to the causal pattern shown in 1b, however, Figure 1c was, in fact, generated by a spurious model (shown in Figure 2c). In this model, like the model which produced 1a, the correlation between X and Y is due to the spurious variable, Z. The only difference between the two spurious models is that in Figure 1a the autocorrelations of X and Y are equal while in 1c the autocorrelation of Y is greater than the autocorrelation of X, and yet in Figure 1c cross-lagged panel analysis would indicate incorrectly that X was causing Y. Unequal autocorrelations can also bias the cross-lagged correlations in causal relationships. In general, as Rogosa (1980) has pointed out, when the causal or spurious effects on X and Y are equal, cross-lagged panel analysis will attribute causality to the variable with the lower autocorrelations.

The simulated examples presented up to this point have dealt with situations in which the causal interval was smaller than the smallest measurement interval. This was simulated by having causal or spurious effects occur synchronously. Since the time periods used in simulation are arbitrary, it is also possible to simulate situations in which the causal interval is longer than the shortest measurement interval by using lagged causal or spurious factors. This procedure is used in Figure 3 to illustrate another situation in which the results of cross-lagged panel analysis can be misleading (Figure 4 shows the path models which correspond to the graphs in Figure 3). While the correlation patterns in all of the graphs in Figure 3 would produce cross-lagged differences at certain measurement intervals, only one, Figure 3a, was produced by a causal

Figure 3. Simulated cross-correlations for models with lagged one-way causal and spurious relationships.

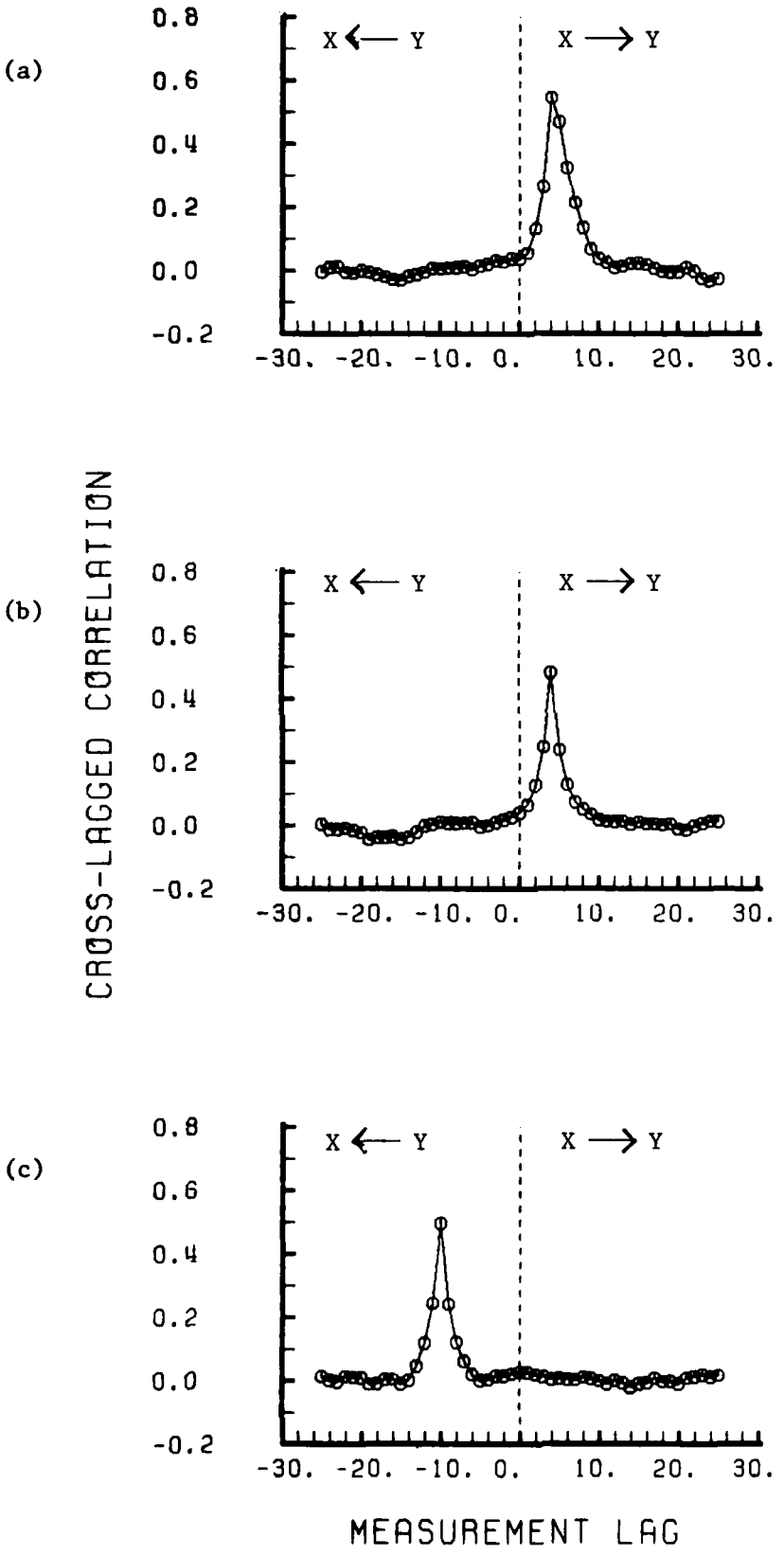
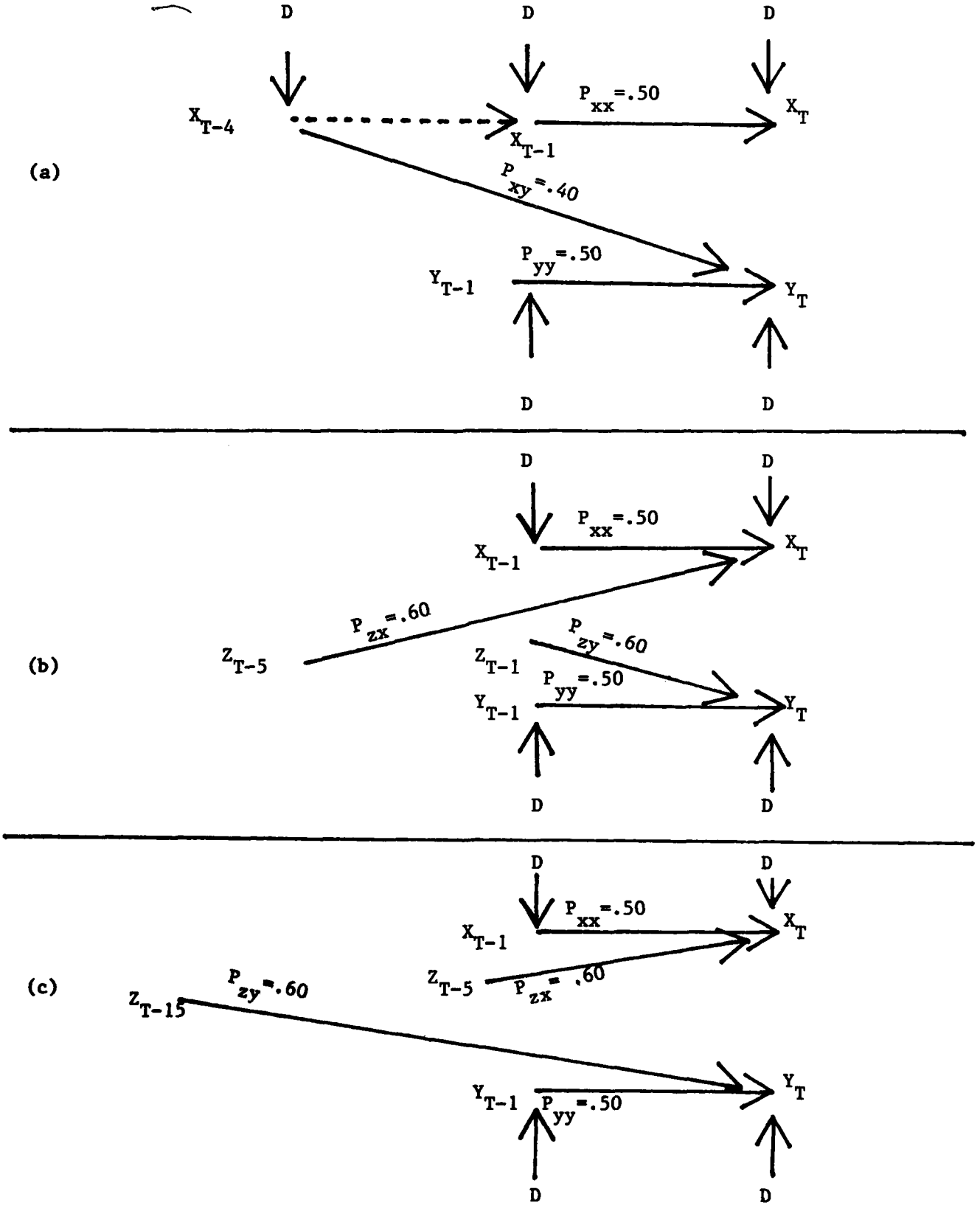


Figure 4. Path models for the equations used to generate the simulated cross-correlations in Figure 3.



relationship.

In Figure 3a, X caused Y with a path coefficient of .40 and a causal lag of 4 measurement intervals. As is appropriate for the underlying causal model, the maximum cross-lagged difference in Figure 3a occurs at a measurement lag of 4. On the other hand, Figure 3b shows a pattern of correlations almost identical to Figure 3a, generated by a spurious model in which a third variable, Z, caused X after 5 measurement intervals, and Y after 1 measurement interval. Just like the causal relationship in Figure 3a, the spurious relationship in Figure 3b would produce a maximum cross-lagged difference at a measurement lag of 4.

Generally, in a lagged spurious relationship such as 3b, the maximum cross-lagged difference will occur at a point which is the difference between the two lags for the effect of the spurious variable. Thus in Figure 3b, the maximum cross-lagged correlation occurred at 5-1=4. Figure 3c also shows a lagged spurious relationship, this time Z causes X with a lag of 5 and Y with a lag of 15. In this case the maximum cross-lagged correlation would be expected to (and does) occur at 5-15= -10.

It should be apparent from the preceding discussion that the utility of cross-lagged panel analysis for distinguishing between spurious and causal relationships in situations with one way causality is negligible. A similar situation exists when cross-lagged panel analysis is applied to co-causal relationships. While it could be argued that cross-lagged panel analysis was never intended for use in co-causal relationships, the fact is that very few researchers using cross-lagged panel analysis even entertain the idea that the variables under study may be co-causal.

As will be shown below, this practice can lead to misleading and seemingly contradictory results.

The graphs in Figure 5 show simulated cross correlations from two co-causal relationships. They are similar to a graph originally presented in Pelz and Lew (1970), and correspond to the path models shown in Figure 6. In Figure 5a, X causes Y after a delay of three time periods and Y causes X after a delay of 10 time periods. The path coefficients for the autocorrelations for both X and Y were .50 while the path coefficients for the cross correlations (X causing Y, and Y causing X) were .40. Because of the dual peaks in the correlations, cross-lagged panel studies examining this data and using measurement intervals near 3 or 19 time periods would conclude that X causes Y. On the other hand, studies which used measurement intervals near 10 and 25 would come to the opposite conclusion, that Y causes X. While neither of these conclusions is strictly wrong, a researcher looking only at the two wave cross-lagged differences would be blind to the actual co-causal nature of the relationship. It should also be noted that researchers dealing with variables similar to those simulated in Figure 5a, who replicated their two wave study at different measurement intervals (as Kenny, 1975, recommends) would find that their various replications would give conflicting results. Even more alarming in this regard is the case of a reciprocal co-causal relationship, such as the one shown in Figure 5b. Figure 5b was generated with a model similar to the one used in 5a, except the coefficient for Y causing X was made negative (representing a negative feedback loop). In this case, a researcher using multiple replications would find that the sign of the cross-lagged difference and the signs of the cross-lagged

Figure 5. Simulated cross-correlations for two co-causal models.

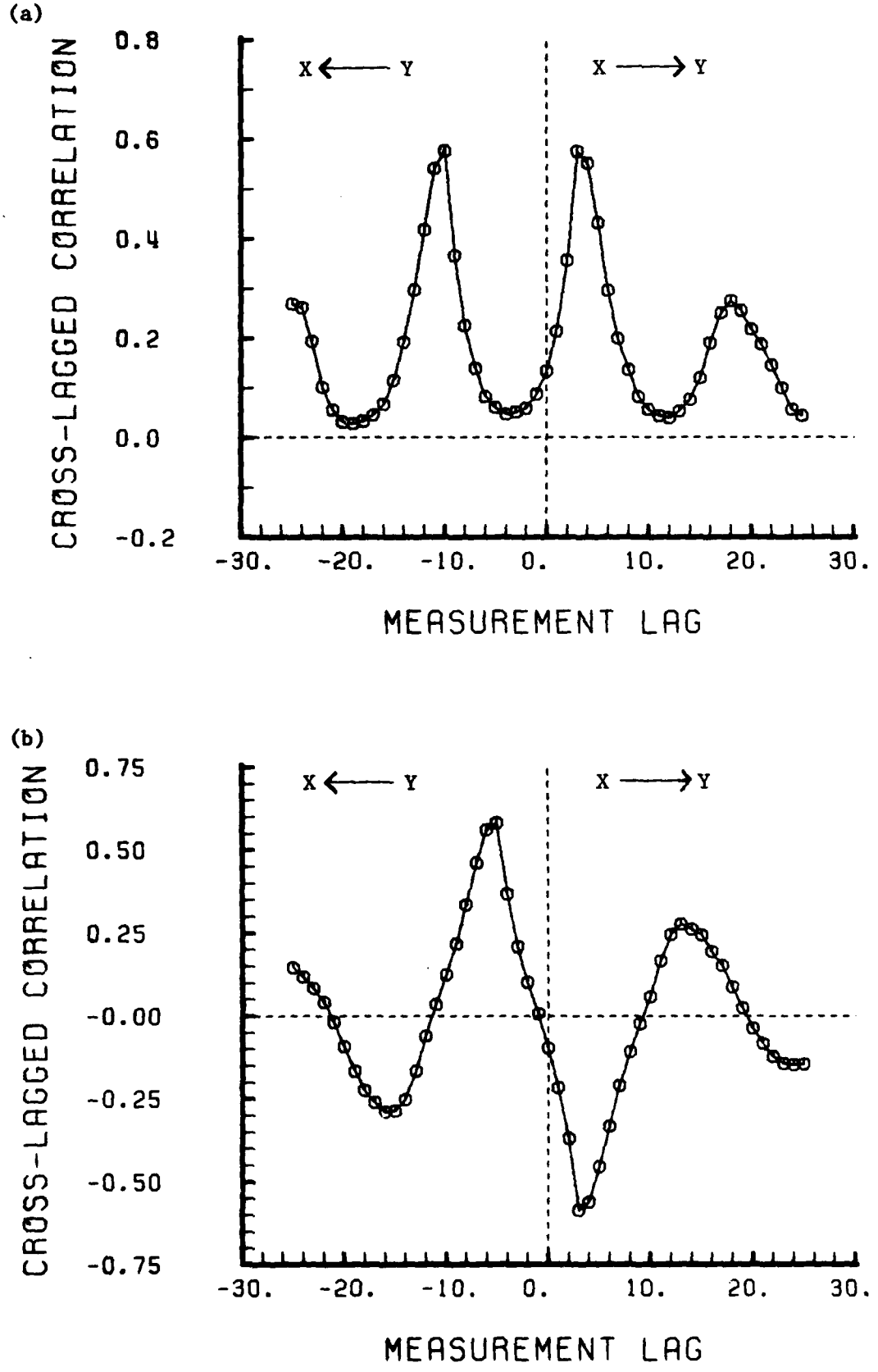
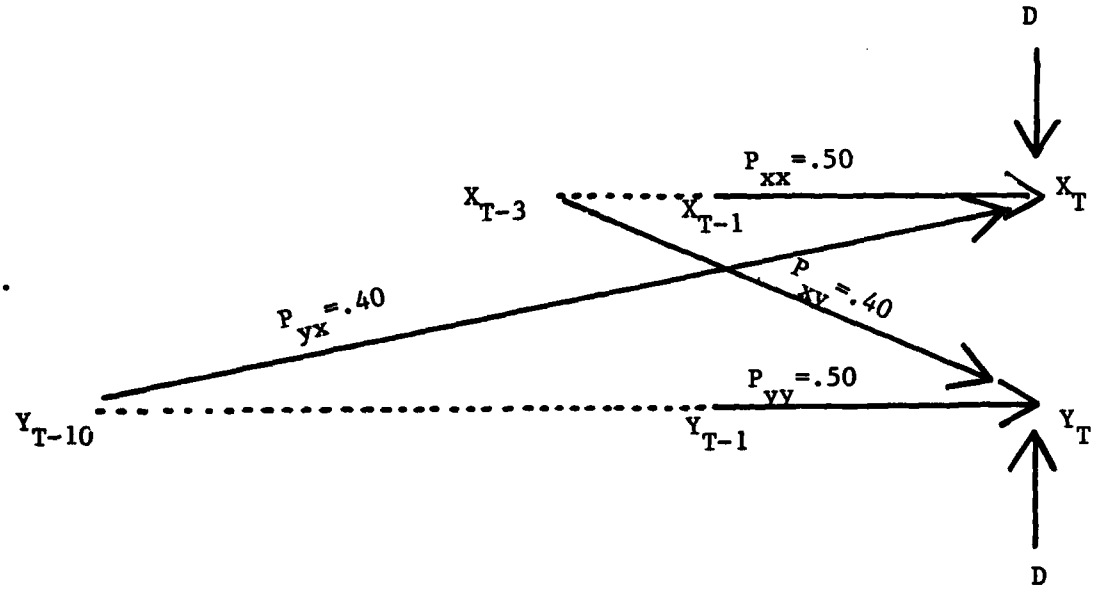
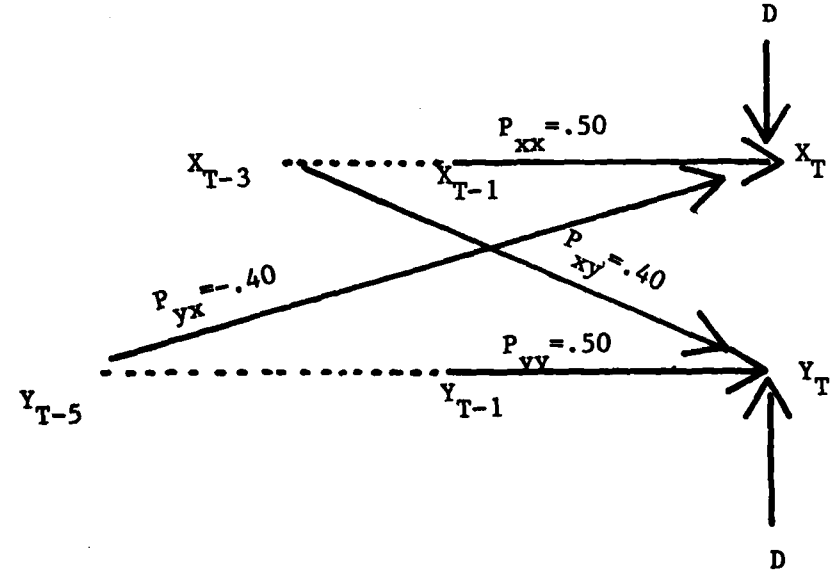


Figure 6. Path models of equations used to generate simulated cross-lagged correlations shown in Figure 5.

7a.



7b.

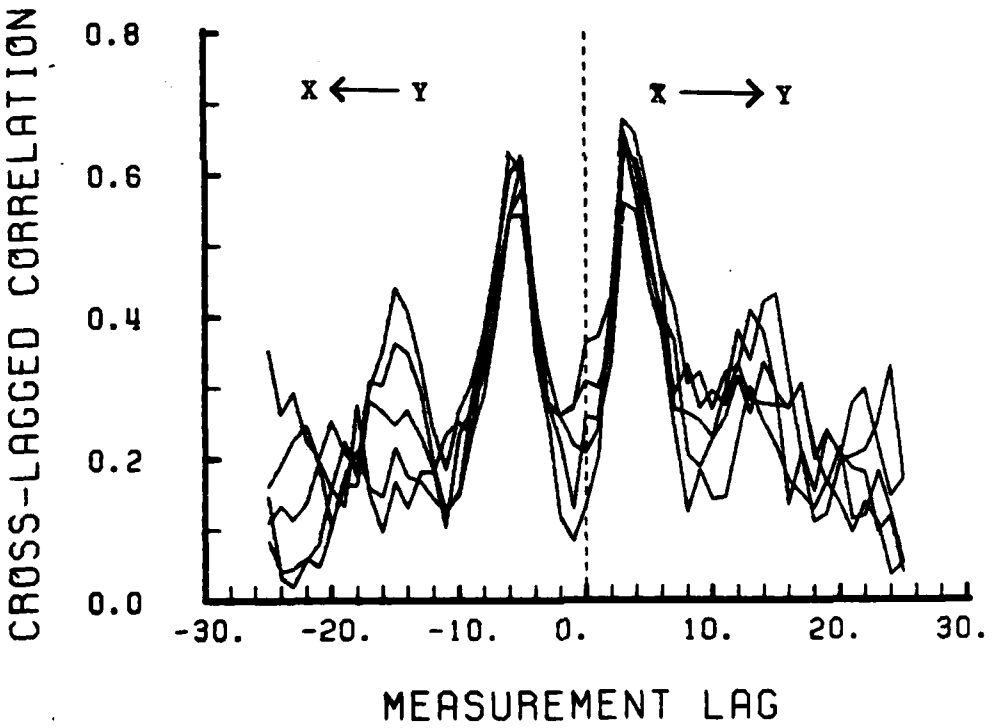


correlations would reverse themselves at various measurement intervals; a situation for which there is no basis in the standard models for cross-lagged panel analysis.

One final problem which the simulation revealed was a fair amount of instability in cross-lagged correlations, especially when the measurement interval deviated from the causal interval. Although the curves presented so far look fairly smooth they are, in fact, average curves with each point based on many correlations. Figure 7 shows a graph of individual correlations from a relationship similar to that shown in Figure 5a. The five different curves plotted in Figure 7 represent five different runs of the simulation (changing only the sequence of random numbers used to simulate error). The figure shows that even with a fairly large N (200 cases were used in the simulation) cross-lagged correlations can vary randomly over a fairly wide range when the measurement interval deviates from the causal interval.

To deal with the instability problem, the curves in Figures 2 through 6 were smoothed by calculating every possible non-redundant correlation from the waves of simulated data represented in the graph and then averaging all the correlations with a given lag. For example, correlations between X_1Y_2, X_2Y_3, X_3Y_4 all have a lag of 1 and would be averaged together. The average correlations are then plotted as a function of measurement lag. For example, in the simulation which used 50 waves, cross-correlations can be estimated at lags up to 50 time periods. One limitation to this technique is that averaged correlations at the longer lags are made up of fewer individual correlations than averages representing shorter lags. In the present example

Figure 7. Simulated cross-correlations from a co-causal model which have not been averaged.



there are 50 correlations with a lag of 1 but only 26 correlations with a lag of 25. If the longest possible lag of 50 were of interest, only 1 correlation would be available from the simulated data and no average could be calculated.

Based on the information presented above, it is apparent that using cross-time correlations to infer causality is an extremely hazardous procedure which works only under highly specific and idealized conditions. The distinctive double-peak pattern found in Figures 5a and 5b might be useful for identifying co-causal relationships in studies with a large number of replications and a measurement interval shorter than the causal interval. However, such data are the exception rather than the rule in behavioral research. On the other hand, cross-time correlations can be useful in the predictive sense. It is certainly useful to know that variable Y at time 2 can be predicted to some degree by variable X at time 1, and cross-time correlations can provide that information. However, the broader question of whether purposefully manipulating X at time 1 will produce a corresponding change in Y at time 2 (i.e., whether X causes Y) apparently cannot be answered using present cross-lagged correlation techniques.*

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* It should be pointed out that, like cross-lagged panel analysis, neither regression nor path models can answer the question of causality, except by assumption.

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